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TRANSACTIONS

OF THE

AMERICAN

SURGICAL ASSOCIATION.

VOLUME THE SIXTEENTH.

EDITED BY

DE FOREST WILLARD, A.M., M.D., PH.D.,

RECORDER OF THE ASSOCIATION.

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OFFICERS OF THE ASSOCIATION,

ELECTED APRIL 21, 1898.

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WILLIAM W. KEEN, A.M., M.D., LL.D.

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SOLON MARKS, M.D.

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HERBERT L. BURRELL, M.D.,
22 Newbury Street, Boston.

TREASURER.

GEORGE RYERSON FOWLER, M.D.,
301 De Kalb Avenue, Brooklyn.

RECORDER.

DE FOREST WILLARD, A.M., M.D.,
1601 Walnut Street, Philadelphia.

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WILLIAM W. KEEN, M.D.,
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DE FOREST WILLARD, M.D.,
G. R. FOWLER, M.D.,
} *Ex-officio.*

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CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS, WASHINGTON MEETING, 1900.

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Alternate, F. H. GERRISH, M.D.

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Created in 1898.

ROSWELL PARK, M.D.
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HERBERT L. BURRELL, M.D.

Place of next Meeting—CHICAGO, MAY, 1899.

COMMITTEE OF ARRANGEMENTS.

NICHOLAS SENN, M.D.
JOHN E. OWENS, M.D.
CHRISTIAN FENGER, M.D.

LIST OF THE PRESIDENTS

OF THE

ASSOCIATION FROM THE TIME OF ITS INSTITUTION.

ELECTED

1880.† SAMUEL DAVID GROSS, M.D., LL.D., D.C.L. Oxon., LL.D. Cantab., LL.D. Edin.—Founder of the Association.

1883. EDWARD MOTT MOORE, M.D., LL.D.

1884.† WILLIAM THOMPSON BRIGGS, M.D.

1885.† MOSES GUNN, A.M., M.D., LL.D.

1886. HUNTER McGUIRE, M.D., LL.D.

1887.† D. HAYES AGNEW, M.D., LL.D.

1888. DAVID WILLIAMS CHEEVER, M.D., LL.D.

1889.† DAVID W. YANDELL, M.D.

1890. CLAUDIUS HENRY MASTIN, M.D., LL.D.

1891. PHINEAS SANBORN CONNER, M.D., LL.D.

1892. NICHOLAS SENN, M.D., Ph.D., LL.D.

1893. J. EWING MEARS, A.M., M.D.

1894. FREDERIC SHEPARD DENNIS, M.D.

1895. LOUIS McLANE TIFFANY, A.M. Cantab., M.D.

1896. JOHN COLLINS WARREN, M.D.

1897. THEODORE F. PREWITT, M.D.

1898. WILLIAM W. KEEN, A.M., M.D., LL.D.

† Deceased.

NOTICE.

THIS volume of TRANSACTIONS contains the papers read before the Association at the Meeting held April 19, 20, and 21, 1898.

The Association assumes no responsibility for the statements and opinions published in this volume.

FELLOWS

OF THE

AMERICAN SURGICAL ASSOCIATION.

MAY, 1898.

* Denotes Original Fellows.

ELECTED

1890. ABBE, ROBERT, M.D., 13 West Fiftieth Street, New York. Surgeon to St. Luke's Hospital.

1894. ALLEN, DUDLEY P., A.M., M.D., 278 Prospect Street, Cleveland, Ohio. Professor of Surgery, Medical Department Western Reserve University; Visiting Surgeon, Lakeside and Charity Hospitals; Consulting Surgeon to the Cleveland City Hospital.

1890. ALLIS, OSCAR HUNTINGTON, A.M., M.D., 1604 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

*1880. ASHHURST, JOHN, Jr., M.D., LL.D., 2000 West De Lancey Place, Philadelphia. Professor of Surgery and of Clinical Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania Hospital; Senior Surgeon to the Children's Hospital. *Vice-President*, 1896.

1882. BARTON, JAMES M., A.M., M.D., 1337 Spruce Street, Philadelphia. Surgeon to the Jefferson Medical College Hospital and to the Philadelphia Hospital.

1896. BAXTER, GEORGE A., A.M., M.D., Chattanooga, Tennessee. Professor of Surgery, Chattanooga Medical College; Surgeon to Queen & Crescent and to Southern Systems; Surgeon to Nashville & Chattanooga, to Chattanooga Union, to Lookout Mountain, and to Electric System of Railways.

ELECTED

1882. Bontecou, Reed Brockway, M.D., 82 Fourth Street, Troy, N. Y. Surgeon to the Marshall Infirmary.

1890. Bradford, Edward Hickling, A.B., M.D., 133 Newbury Street, Boston. Surgeon to the Children's and the Samaritan Hospitals; Assistant Professor of Orthopædic Surgery in Harvard University.

*1880. Brinton, John H., M.D., 1423 Spruce Street, Philadelphia. Professor of the Practice of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital. *Treasurer*, 1884–85.

1895. Bryant, Joseph D., M.D., 54 West Thirty-sixth Street, New York. Professor of Anatomy and of Operative and Clinical Surgery, Bellevue Hospital Medical College; Surgeon to Bellevue and St. Vincent's Hospitals; Consulting Surgeon to Gouverneur Hospital, Hospital for Ruptured and Crippled, St. Joseph's and Hackensack Hospitals, Asylum for Insane, New York, etc.

1882. Bull, William Tillinghast, A.B., M.D., 35 West Thirty-fifth Street, New York. Adjunct Professor of the Practice of Surgery and of Clinical Surgery in the College of Physicians and Surgeons, New York; Surgeon to the New York and St. Luke's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled, and to the New York Cancer Hospital.

1893. Burrell, Herbert Leslie, M.D. (Harvard), *Secretary*, 22 Newbury Street, Boston, Mass. Assistant Professor of Clinical Surgery in Harvard University; Visiting Surgeon, Boston City Hospital; Visiting Surgeon, The Children's Hospital; Consulting Surgeon, Carney Hospital and the Quincy Hospital.

1889. Cabot, Arthur Tracy, A.M., M.D., 3 Marlborough Street, Boston, Mass. Surgeon to the Massachusetts General Hospital.

1885. Carmalt, William H., A.M., M.D., 87 Elm Street, New Haven, Conn. Professor of Surgery in Yale University; Surgeon to the New Haven Hospital. *Vice-President*, 1895.

1896. Carson, Norman Bruce, M.D., 209 North Jefferson Avenue, St. Louis, Mo. Professor of Clinical Surgery in St. Louis

ELECTED

Medical College; Surgeon to the St. Louis, Mullanphy, and Martha Parsons' Hospitals, St. Vincent Insane Asylum, etc.

1882. CHEEVER, DAVID WILLIAMS, M.D., LL.D., 557 Boylston Street, Boston, Mass. Professor of Surgery (Emeritus) in Harvard University; Surgeon to the Boston City Hospital. *President*, 1888.

1896. COLE, CHARLES KNOX, A.M., M.D., Helena, Montana. Surgeon to St. John's, St. Peter's, and County Hospitals.

1898. COLEY, WILLIAM B., M.D., 5 Park Avenue, New York. Attending Surgeon to the New York Cancer Hospital; Assistant Surgeon to the Hospital for Ruptured and Crippled.

*1880. CONNER, PHINEAS SANBORN, M.D., LL.D., 159 West Ninth Street, Cincinnati, Ohio. Professor of Surgery in the Medical College of Ohio; Professor of Surgery, Dartmouth Medical College; Surgeon to the Cincinnati and the Good Samaritan Hospitals. *President*, 1891; *Member of Council*, 1883 and 1895–98; *Treasurer*, 1885–91.

1896. CURTIS, BENJAMIN FARQUHAR, A.B., M.D., 7 East Forty-first Street, New York. Professor of Clinical Surgery in the New York Post-Graduate Medical School, and Women's Medical College of the New York Infirmary; Surgeon to St. Luke's and New York Cancer Hospitals; Consulting Surgeon to New York Orthopædic Hospital and Dispensary, and the New York Infirmary for Women and Children.

1896. CUSHING, HAYWARD WARREN, A.B., M.D., 70 Commonwealth Avenue, Boston, Mass. Assistant Visiting Surgeon, Boston City Hospital; Assistant Surgeon, Children's Hospital, Boston.

1897. DA COSTA, JOHN CHALMERS, M.D., 1629 Locust Street, Philadelphia, Pa. Clinical Professor of Surgery, Jefferson Medical College; Surgeon to the Philadelphia and the Phœnixville Hospitals, and to the Pennsylvania Training School for Feeble Minded, Elwyn, Pa.

1883. DANDRIDGE, NATHANIEL PENDLETON, M.D., 422 Broadway, Cincinnati, Ohio. Professor of Practice of Surgery and of Clinical Surgery in the Miami Medical College, Cincinnati. *Treasurer*, 1894–96.

ELECTED

1892. DEAVER, JOHN B., M.D., 1634 Walnut Street, Philadelphia. Professor of Applied Anatomy, University of Pennsylvania; Surgeon to the Philadelphia and German Hospitals, Philadelphia.

1882. DENNIS, FREDERIC SHEPARD, M.D., 542 Madison Avenue, New York. Professor of Clinical Surgery, Cornell University, New York City; Surgeon to the Bellevue and St. Vincent's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled. *President*, 1894; *Vice-President*, 1887; *Member of Council*, 1889.

1893. ELLIOT, JOHN WHEELOCK, A.M., M.D. (Harvard), 124 Beacon Street, Boston. Surgeon to Massachusetts General Hospital.

1896. ESTES, WILLIAM LAWRENCE, A.M., M.D., South Bethlehem, Penna. Director and Surgeon-in-Chief of St. Luke's Hospital; Lecturer on Hygiene at Lehigh University.

1898. EVE, DUNCAN, A.M., M.D., 700 Church Street, Nashville, Tenn. Surgeon to the Nashville City Hospital; Chief Surgeon, Nashville, Chattanooga & St. Louis R.R.; Professor of Surgery and Clinical Surgery, Medical Department Vanderbilt University, Nashville.

1883. FENGER, CHRISTIAN, M.D., 269 La Salle Avenue, Chicago. Professor of Clinical Surgery in the Northwestern University Medical School and the Chicago Polyclinic; Surgeon to Emergency, German, Mercy, and Norwegian Hospitals. *Vice-President*, 1895.

1882. FORBES, WILLIAM SMITH, M.D., 901 Pine Street, Philadelphia. Professor of Anatomy in the Jefferson Medical College of Philadelphia; Surgeon to the Protestant Episcopal Hospital.

1891. FOWLER, GEORGE RYERSON, M.D., *Treasurer*, 301 De Kalb Avenue, Brooklyn, New York. Professor of Surgery, New York Polyclinic; Examiner in Surgery, Medical Examining Board of Regents, University State of New York; Surgeon to the Methodist Episcopal Hospital and the Brooklyn Hospital; Consulting Surgeon to the Norwegian, the Relief (E. D.), and the Bushwick Hospitals; Division Surgeon of Seventh Army Corps.

ELECTED

1898. FREEMAN, LEONARD, B.S., M.D., California Building, Denver, Col. Professor of Surgery, Gross Medical College; Surgeon to the Arapahoe County Hospital and to St. Anthony's Hospital.

1891. GASTON, JAMES MCFADDEN, A.B., M.D., 421 Capitol Avenue, Atlanta, Georgia. Professor of Surgery in Southern Medical College. *Vice-President*, 1897.

1882. GAY, GEORGE WASHINGTON, M.D., 665 Boylston Street, Boston, Mass. Surgeon to the Boston City Hospital; Clinical Instructor in Surgery in Harvard University. *Member of Council*, 1882.

1892. GERRISH, FREDERIC HENRY, A.M., M.D., 675 Congress Street, Portland, Maine. Consulting Surgeon, Maine General Hospital; Professor of Anatomy in Medical Department of Bowdoin College.

1890. GERSTER, ARPAD G., M.D., Chir.D., 34 East Seventy-fifth Street, New York. Professor of Surgery in the New York Polyclinic; Surgeon to the German and Mount Sinai Hospitals.

1892. HALSTED, WILLIAM STEWART, B.A., M.D., 1201 Eutaw Place, Baltimore, Maryland. Surgeon to Johns Hopkins Hospital.

1898. HARRINGTON, FRANCIS B., M.D., 201 Beacon Street, Boston, Mass. (A.B., Tuft's College; M.D., Harvard College). Surgeon to Massachusetts General Hospital.

1895. HARTE, RICHARD H., M.D., 1503 Spruce Street, Philadelphia. Demonstrator of Osteology in the University of Pennsylvania; Surgeon to the Pennsylvania and Episcopal Hospitals; Assistant Surgeon to the University Hospital; Consulting Surgeon, St. Mary's and St. Timothy's Hospitals.

1898. HEARN, W. JOSEPH, M.D., 1120 Walnut Street, Philadelphia. Clinical Professor of Surgery, Jefferson Medical College; Visiting Surgeon to the Philadelphia Hospital; Consulting Surgeon to the Phœnixville General Hospital.

1889. HOMANS, JOHN, A.B., M.D., 164 Beacon Street, Boston. Surgeon to the Massachusetts General Hospital.

ELECTED

1896. JOHNSTON, GEORGE BEN, M.D., 207 East Grace Street, Richmond, Va. Professor of the Practice of Surgery and of Clinical Surgery in the Medical College of Virginia; Surgeon to the Old Dominion Hospital, and Consulting Surgeon to the Richmond City Free Dispensary.

*1880. KEEN, WILLIAM WILLIAMS, A.M., M.D., LL.D., *President*, 1729 Chestnut Street, Philadelphia. Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital and to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to the Woman's and St. Agnes Hospitals; Membre Correspondant Etrangé de la Société de Chirurgie de Paris; Membre Honoraire de la Société Belge de Chirurgie. *Vice-President*, 1892.

1890. LANE, LEVI COOPER, A.M., M.D., M.R.C.S. Eng., LL.D., San Francisco, Cal. Professor of Surgery in the Cooper Medical College, San Francisco. *Vice-President*, 1891.

1889. LANGE, FREDERICK E., M.D., 691 Lexington Avenue, New York.

*1880. MARKS, SOLON, M.D., *Vice-President*, 136 Wisconsin Street, Milwaukee, Wis. Surgeon to St. Mary's Hospital.

1898. MARTIN, EDWARD, M.D., 415 S. Fifteenth Street, Philadelphia. Clinical Professor of Genito-Urinary Diseases, University of Pennsylvania; Clinical Professor of Surgery, Woman's Medical College, Philadelphia; Physician to Philadelphia, St. Agnes, and Howard Hospitals; Brigade Surgeon, Third Regiment, N. G. P.

*1880. MASTIN, CLAUDIUS HENRY, M.D., LL.D. (Univ. of Penna.), Northwest corner Joachim and Conti Streets, Mobile, Ala. *President*, 1890; *Vice-President*, 1889; *Member of Council*, 1891, '94, '95.

1887. MASTIN, WILLIAM MCDOWELL, M.D., Northwest corner of Joachim and Conti Streets, Mobile, Ala.; Surgeon to the Mobile City Hospital.

ELECTED

1895. MATAS, RUDOLPH, M.D., 2255 St. Charles Street, New Orleans, La. Professor of Surgery, Medical Department Tulane University; Professor of Clinical Surgery, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital.

1896. MCCOSH, ANDREW J., B.A., M.D., 22 East Fifty-sixth Street, New York. Surgeon to the Presbyterian Hospital; Clinical Lecturer on Surgery, College of Physicians and Surgeons.

1882. MCGRAW, THEODORE A., M.D., 107 West Fort Street, Detroit, Michigan. Professor of Surgery in the Detroit Medical College; Surgeon to St. Mary's and the Harper Hospitals. *Vice-President*, 1896.

*1880. MCGUIRE, HUNTER, M.D., LL.D., 513 East Grace Street, Richmond, Va. President of the College of Physicians and Surgeons and Professor of Clinical Surgery. *President*, 1886; *Member of Council*, 1880–85.

*1880. MEARS, J EWING, A.M., M.D., 1429 Walnut Street, Philadelphia. Professor of Anatomy and of Clinical Surgery in the Pennsylvania College of Dental Surgery. *President*, 1893; *Recorder*, 1881–93.

1898. MILLER, TRUMAN W., M.D., 174–76 E. Chicago Avenue, Chicago. Professor of General and Genito-Urinary Surgery, Chicago Polyclinic; Chief Surgeon, Grand Trunk Railway System and North and West Chicago Cable and Electric Lines; Vice-President, Military Surgeons' Association, I. N. G.

1893. MIXTER, SAMUEL JASON, S.B. (Massachusetts Institute of Technology), M.D. (Harvard), 180 Marlborough Street, Boston. Surgeon to Massachusetts General Hospital and to Carney Hospital; Consulting Surgeon to the Massachusetts Charity Eye and Ear Infirmary; Instructor in Surgery in the Harvard University.

1896. MONKS, GEORGE HOWARD, A.B. (Harvard), M.D. (Harvard), M.R.C.S. (Eng.), 405 Boylston Street, Boston. Surgeon to Carney Hospital; Assistant Visiting Surgeon, Boston City Hospital; Instructor in Clinical and Assistant in Operative Surgery, Harvard Medical School; Instructor in Surgical Pathology, Harvard Dental School.

ELECTED

1895. MOORE, JAMES E., M.D., 802 Dayton Building, Minneapolis, Minn. Professor of Clinical Surgery, University of Minnesota; Surgeon to St. Barnabas and Northwestern Hospitals; Consulting Surgeon to St. Mary's and City Hospitals.

*1880. MORTON, THOMAS GEORGE, M.D., 1421 Chestnut Street, Philadelphia. Surgeon to the Pennsylvania, the Orthopædic, and the Jewish Hospitals.

1898. MORTON, THOMAS S. K., 1506 Locust Street, Philadelphia. Professor of Surgery, Philadelphia Polyclinic and College for Graduates in Medicine; Surgeon to the Out-Patient Department of the Pennsylvania Hospital; Assistant Surgeon to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases.

1886. MUDD, HENRY H., M.D., 2604 Locust Street, St. Louis, Mo. Professor of Surgical Anatomy and Clinical Surgery in St. Louis Medical College; Surgeon to St. Luke's Hospital.

1898. MURRAY, FRANCIS W., M.D., 32 W. Thirty-ninth Street, New York City. Professor of Clinical Surgery in Cornell University Medical College; Surgeon to the New York and St. Luke's Hospitals.

1882. NANCREDE, CHARLES BEYLARD, A.M., M.D., Ann Arbor, Mich. Professor of Surgery in the University of Michigan. *Vice-President*, 1889.

1882. OWENS, JOHN E., M.D., 1806 Michigan Avenue, Chicago. Professor of Principles and Practice of Surgery and Clinical Surgery in the Chicago Medical College; Surgeon to St. Luke's Hospital.

*1880. PACKARD, JOHN H., M.D., 225 South Sixteenth Street, Philadelphia. Surgeon to St. Joseph's Hospital. *Treasurer*, 1880–83.

1885. PARK, ROSWELL, A.M., M.D., 510 Delaware Avenue, Buffalo, N. Y. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital. *Vice-President*, 1893; *Member of Council*, 1893–94.

ELECTED

1896. PARKHILL, CLAYTON, M.D., 205–6 McPhee Building, Denver, Col. Dean of the Colorado School of Medicine, Medical Department of the University of Colorado, and Professor of the Principles and Practice of Surgery and Clinical Surgery in the same; Surgeon to St. Luke's and the Arapahoe County Hospitals, Denver; Surgeon-in-Chief to the Citizens' Hospital, Aspen, Col.; Consulting Surgeon to the State Hospital for the Insane, Pueblo, Col.; Surgeon-General of the National Guard of Colorado.

1893. PARMENTER, JOHN, M.D., 519 Franklin Street, Buffalo, N. Y. Professor of Anatomy and Clinical Surgery in the Medical Department of the University of Buffalo; Surgeon to the Erie County, Fitch, and Children's Hospitals; Assistant Surgeon to the Buffalo General Hospital.

1889. PILCHER, LEWIS S., A.B., M.D., 145 Gates Avenue, Brooklyn, N. Y. Professor of Clinical Surgery in the Post-Graduate Medical School, New York; Surgeon to the Methodist Episcopal Hospital. *Vice-President*, 1893.

1887. PORTER, CHARLES BURNHAM, A.M., M.D. (Harv.), 5 Arlington Street, Boston, Mass. Professor of Clinical Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *Vice-President*, 1892.

1882. PORTER, WILLIAM GIBBS, M.D., 1118 Spruce Street, Philadelphia. Surgeon to the Presbyterian and Philadelphia Hospitals.

1896. POWERS, CHARLES A., M.D., Fourteenth and Stout Streets, Denver, Col. Professor of Surgery in the University of Denver, and Surgeon to the Arapahoe County Hospital.

1882. PREWITT, THEODORE F., M.D., 3101 Pine Street, St. Louis, Mo. Professor of the Principles and Practice of Surgery and Clinical Surgery in the Missouri Medical College; Surgeon to St. John's Hospital. *President*, 1897; *Vice-President*, 1886; *Member of Council*, 1894–96.

1886. RANSOHOFF, JOSEPH, M.D., F.R.C.S. (Eng.), 706 Walnut Street, Cincinnati, Ohio. Professor of Anatomy in the Medical College of Ohio; Surgeon to the Cincinnati and the Good Samaritan Hospitals.

ELECTED

1887. Richardson, Maurice Howe, A.B., M.D., 224 Beacon Street, Boston, Mass. Surgeon to the Massachusetts General Hospital; Assistant Professor of Clinical Surgery in Harvard University. *Vice-President*, 1897; *Secretary*, 1894–96.

1882. Roberts, John B., A.M., M.D., 1627 Walnut Street, Philadelphia. Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Methodist and the Jewish Hospitals. *Vice-President*, 1888 and 1894; *Treasurer*, 1892–93.

1898. Rodman, William L., A.M., M.D., northwest corner Second and Walnut Streets, Louisville, Ky. Professor of Surgery and Clinical Surgery in the Kentucky School of Medicine, and Professor of the Principles of Surgery and Clinical Surgery in the Medico-Chirurgical College, Philadelphia; Surgeon at the Louisville City, St. Mary, and St. Elizabeth Hospitals.

1882. Rushmore, John Dikeman, M.D., 129 Montague Street, Brooklyn, N. Y. Professor of Surgery in the Long Island College Hospital; Surgeon to the Brooklyn, the St. Peter's, and the Eye and Ear Hospitals.

*1880. Sayre, Lewis Albert, M.D., 285 Fifth Avenue, New York. Professor of Orthopædic Surgery in the Bellevue Hospital Medical College; Consulting Surgeon to the Bellevue, the Charity, and the St. Elizabeth's Hospitals, and to the Home for Incurables.

1882. Senn, Nicholas, M.D., Ph.D., LL.D., 532 Dearborn Avenue, Chicago, Ill. Professor of the Principles of Surgery and Clinical Surgery in Rush Medical College; Surgeon to the Presbyterian Hospital; Surgeon-in-Chief to St. Joseph's Hospital. *President*, 1892; *Member of Council*, 1897.

1895. Souchon, Edmond, M.D., 135 Baronne Street, New Orleans, La. Professor of Anatomy and of Clinical Surgery, Tulane University; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital.

1885. Thompson, J. Ford, M.D., 1401 H Street, N. W., Washington, D. C. Professor of Surgery in the National Medical College; Surgeon to the Garfield Memorial and the Children's Hospitals.

ELECTED

1882. THOMSON, WILLIAM, M.D., 1426 Walnut Street, Philadelphia. Honorary Professor of Ophthalmology in the Jefferson Medical College Hospital.

1882. TIFFANY, LOUIS MCLANE, A.M. (Cantab.), M.D., 831 Park Avenue, Baltimore, Md. Professor of Surgery in the University of Maryland; Surgeon to the University Hospital. *President*, 1895; *Member of Council*, 1885–89, and 1896–97.

1882. VANDER VEER, ALBERT, A.M., M.D., Ph.D., *Vice-President*, 28 Eagle Street, Albany, N. Y. Professor of Didactic Abdominal Surgery and of Clinical Surgery in the Albany Medical College; Consulting Surgeon to St. Peter's Hospital; Attending Surgeon to the Albany Hospital.

1891. WALKER, EDWARD W., M.D., 96 West Eighth Street, Cincinnati, Ohio. Professor of Surgery, Miami Medical College.

1882. WARREN, JOHN COLLINS, M.D., 58 Beacon Street, Boston, Mass. Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *President*, 1896; *Vice-President*, 1890; *Member of Council*, 1897.

1896. WATSON, FRANCIS SEDGWICK, A.B., M.D., 92 Marlborough Street, Boston. Surgeon to the Boston City Hospital; Instructor in Genito-Urinary Surgery, Harvard Medical School.

1889. WEEKS, STEPHEN H., M.D., 662 Congress Street, Portland, Maine. Professor of Surgery in the Medical School of Maine; Surgeon to Maine General Hospital. *Member of Council*, 1893.

1889. WEIR, ROBERT F., M.D., 37 West Thirty-third Street, New York. Professor of Clinical Surgery in the College of Physicians and Surgeons; Surgeon to the New York Hospital; Consulting Surgeon to the Roosevelt and St. Luke's Hospitals. *Member of Council*, 1893–1896.

*1880. WEIST, JACOB ROWLAND, A.M., M.D., 118 North Eighth Street, Richmond, Ind. Surgeon to St. Stephen's Hospital. *Vice-President*, 1894; *Secretary*, 1880–94.

1892. WHARTON, HENRY R., A.M., M.D., 1725 Spruce Street, Philadelphia. Demonstrator of Surgery, University of Pennsylvania; Surgeon to the Presbyterian, the Children's, and the Methodist Hospitals; Assistant Surgeon to the University Hospital.

ELECTED

1882. WHITE, J. WILLIAM, M.D., Ph.D., 1810 South Rittenhouse Square, Philadelphia. Professor of Clinical Surgery in the University of Pennsylvania..

1891. WIGHT, JARVIS SHERMAN, A.M., M.D., LL.D., 30 Schermerhorn Street, Brooklyn, N. Y. Professor of Operative and Clinical Surgery, Long Island College Hospital; Surgeon to Long Island College Hospital; Consulting Surgeon to St. Mary's Hospital.

1882. WILLARD, DE FOREST, A.M., M.D. (Univ. of Pa.), Ph.D., *Recorder,* 1601 Walnut Street, Philadelphia. Surgeon to the Presbyterian Hospital; Clinical Professor of Orthopædic Surgery in the University of Pennsylvania; Consulting Surgeon to the Hospital for the Chronic Insane of Pennsylvania, and to the New Jersey Training School for Feeble-minded.

HONORARY FELLOWS.

ELECTED

1885. ANNANDALE, THOMAS, M.R.C.S., M.D., Edin., 34 Charlotte Square, Edinburgh, Scotland. Regius Professor of Clinical Surgery in the University of Edinburgh.

1894. VON BERGMANN, PROF. DR. ERNST, Geh. Med. Rath., Klin. Institut für Chirurgie, Berlin, Germany.

1891. BRYANT, THOMAS, ESQ., F.R.C.S., Eng., 65 Grosvenor Street, Grosvenor Square, London, W., England.

1891. CHIENE, JOHN, F.R.C.S., Edin., M.D., Edin., 26 Charlotte Square, Edinburgh, Scotland. Professor of Surgery in the University of Edinburgh.

1885. CZERNY, PROF. DR. VINCENT, 25 Sophien Strasse, Heidelberg, Germany. Professor of Surgery in the University of Heidelberg.

1885. VON ESMARCH, PROF. DR. FRIEDRICH, 2 Hospitalberg, Kiel, Schleswig-Holstein, Germany. Professor of Surgery in the University of Kiel.

1893. GUSSENBAUER, PROF. DR. CARL, ix. Ferstelgasse 5, Vienna. Imperial and Royal Professor of Surgery and Chief of the Second Surgical Clinic and of the Surgical Institute.

1891. HARRISON, REGINALD, ESQ., F.R.C.S., Eng., 6 Lower Berkeley Street, Portman Square, W., London, England.

1890. HORSLEY, VICTOR ALEXANDER HADEN, F.R.C.S., Eng., 25 Cavendish Square, London, W., England.

1883. HORWITZ, P. J., M.D., 1919 Walnut Street, Medical Director U. S. Navy (Retired), Philadelphia.

1894. KOCHER, PROF. DR. THEODOR, Professor of Surgery, University of Berne, Villette 25, Berne, Switzerland.

1885. LISTER, LORD JOSEPH, M.D., London, F.R.C.S., Eng., D.C.L., LL.D., 12 Park Crescent, London, N. W., England. Professor of Clinical Surgery in King's College.

ELECTED

1886. MacCormac, Sir William, Bart., F.R.C.S., England and Ireland, 13 Harley Street, London, W., England. Surgeon to St. Thomas Hospital.

1894. Macewen, William, M.D., Mast. Surg., 3 Woodside Crescent, Glasgow, Scotland.

*1880. Moore, Edward Mott, M.D., LL.D., 74 South Fitzhugh Street, Rochester, N. Y. Surgeon to St. Mary's Hospital, *President*, 1884.

1887. Ollier, Prof. Dr. Leopold, 3 Quai de la Charité, Lyons, France.

1885. Paget, Sir James, Bart., D.C.L., LL.D., F.R.C.S., Eng., 5 Park Square, N. W., Regent's Park, London, England.

1894. Schede, Prof. Dr., Geh. Med. Rath., Director of Surgery, University Clinic, Bonn, Germany.

1882. Smith, Stephen, A.M., M.D., LL.D., 574 Madison Avenue, New York. Professor of Clinical Surgery in the University Medical College of New York; Surgeon to the Bellevue and the St. Vincent's Hospitals. *Vice-President*, 1890.

1896. Terrier, Dr. Felix, 3 Rue de Copenhague, Paris. Professor of Operative Surgery in the Faculty of Medicine of Paris; Surgeon to the Hôpital Bichat.

* Original Fellows.

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

Article I.—Name.

This society shall be called The American Surgical Association.

Article II.—Object.

The object of this Association shall be the cultivation and improvement of the science and art of surgery, the elevation of the medical profession, and such other matters as may come legitimately within its sphere.

Article III.—Membership.

Section 1. This Association shall consist of active and honorary Fellows.

Sect. 2. The active membership shall be limited to one hundred and twenty-five (125) Fellows. The honorary membership shall be limited to twenty-five (25) Fellows, of whom not more than fifteen (15) shall be foreign and the remainder American.

Sect. 3. Propositions for Fellowship shall be made by Fellows, on blanks furnished by the Secretary of the Association. The proposal of a candidate for Fellowship shall be signed by three Fellows, who shall vouch for his character and standing. No one shall be eligible for Fellowship unless he is thirty years of age and a graduate of five years' standing from a recognized medical college, and has established a reputation as a practitioner, author, teacher or original investigator, and has been recommended by the Council. All propositions for Fellowship shall lie over for one year from the time of their reception by the Association.

Sect. 4. The proposers of a candidate shall, within thirty days of

the reception of the proposal for Fellowship, send to the Secretary a confidential letter, an abstract of which, without the name of the writer, shall be presented by the Secretary to the Council, and the original letter returned to the writer.

SECT. 5. Election to Fellowship shall be by ballot, on the third day of each annual meeting, and if three-fourths of the ballots are favorable the candidate shall be declared elected.

SECT. 6. Fellows after election must qualify within six (6) months by the payment of the initiation fee and annual dues.

SECT. 7. Any candidate for Fellowship that is rejected by the Association cannot again be proposed for membership except after the lapse of two years.

SECT. 8. Honorary Fellows shall be proposed and elected in the same manner as active Fellows. They shall not be required to pay any fees or dues, nor shall they be privileged to vote or hold office.

SECT. 9. The resignation of a Fellow may be accepted by a two-thirds vote of the members present, provided he is not in arrears.

SECT. 10. Any violation of the Constitution or By-Laws, or conduct unbecoming a gentleman, may be punished by a reprimand, suspension, or expulsion.

ARTICLE IV.—OFFICERS.

SECTION 1. The officers of the Association shall consist of a President, two Vice-Presidents, a Secretary, a Treasurer, and a Recorder. There shall also be a Council and a Committee on Annual Meeting.

SECT. 2. Nominations. All officers, including the member of the Council and the two (2) members of the Committee on Annual Meeting, and on every third year a Delegate and Alternate to the Congress of American Physicians and Surgeons shall be nominated by a committee of five Fellows, which committee shall be appointed by the President on the first day of the annual meeting.

SECT. 3. Elections. The election of officers shall take place at the executive session on the third day of the annual meeting. A majority of the votes cast shall constitute an election.

SECT. 4. Vacancies. Any vacancy occurring during the year among the officers of the Association shall be filled by the Council.

BY-LAWS.

Section I.—Meetings.

The annual meeting of the Association shall be held at such time and place as may be designated by a vote of the Association. The selected place of meeting may be changed under extraordinary exigencies by a unanimous vote of the Council. The meeting shall continue for three days, unless otherwise ordered by a majority vote.

Section II.—Special Meetings.

A special meeting may be called at any time by the President, and it shall be his duty to do so upon the requisition in writing of any seven Fellows.

Section III.—Quorum.

For the transaction of business, any number of Fellows at any meeting shall constitute a quorum. For elections, for changes in the Constitution and By-Laws, for ordering assessments or for the appropriation or expenditure of any sum of money exceeding twenty-five dollars, or for any other business affecting the interests of the Association, fifteen Fellows shall be required to form a quorum. For the expulsion of a Fellow, twenty-five Fellows shall be required to form a quorum.

Section IV.—Duties of President and Vice-President.

The President shall preside at the meetings of the Association, preserve order, regulate debates, sign certificates of Fellowship, approve bills, appoint committees not otherwise provided for, announce results of elections, and perform all other duties legitimately appertaining to his office. In his absence the Vice-President, in order of seniority, shall preside. In the absence of both Vice-Presidents the Chair shall be taken by the senior Fellow (by election) of the Council who may be present.

Section V.—Secretary.

The Secretary shall keep the Minutes of the Association, and shall issue, at least six weeks prior to the annual meeting, a preliminary programme of the time and place of meeting and business to be transacted. He shall also issue the final programme of the annual

meeting, and at the same time he shall issue a list of the names of the candidates for Fellowship that are under consideration by the Council. He shall attest all official acts requiring certification, in connection with or independent of the President; notify officers and Fellows of their election; keep in his custody the seal of the Association and affix it to all documents and papers that the Association may direct; take charge of all papers not otherwise provided for. He shall serve as Secretary and keep Minutes of the meetings of the Council and of the Committee on Annual Meeting.

Section VI.—Treasurer.

It shall be the duty of the Treasurer to receive all moneys and funds belonging to the Association. He shall pay all bills when properly ordered by the Association and countersigned by the President, collect all dues and assessments as promptly as possible, report to the Association at each annual meeting the names of all Fellows in arrears, and who have, in accordance with the By-Laws regulating the same, forfeited their Fellowship. He shall present an annual account for audit.

Section VII.—Recorder.

The Recorder shall receive all papers and reports of discussions on papers presented to the Association, and as the Chairman of the Publication Committee shall take charge of their publication.

Section VIII.—Council.

The Council shall consist of three Fellows elected at large, with the President, Secretary, Treasurer, and Recorder *ex officio*. The terms of service of the members shall be three years, and at each annual meeting one shall be elected to take the place of the retiring member.

Stated meetings of the Council may be held at the call of the President, a majority of the members constituting a quorum.

Special meetings of the Council may be held on the call of the President, or at the request of three members of the Council in the interval between the meetings of the Association.

The President of the Association shall be the Chairman, and the Secretary of the Association the Secretary of the Council.

The Council shall be the executive body of the Association, and accurate Minutes of its proceedings, properly indexed, shall be kept by the Secretary.

All propositions for Fellowship shall be submitted to it for action, and the names of those candidates only who have complied with the requirements of the Association and the rules of the Council, and who shall receive its favorable recommendation, shall be presented to the Association for election as Fellows. It shall act as a Board of Censors for the trial of all alleged offences against the Constitution or By-Laws or unprofessional conduct by any Fellow of the Association, and it alone shall have the power of moving their expulsion.

Section IX.—Committee on Annual Meeting.

The Committee on Annual Meeting for each successive year shall consist of two (2) Fellows elected by the Association, and the President, Secretary, and Recorder *ex officio*, together with the Chairman of the local Committee of Arrangements. The committee shall elect its own Chairman.

The duties of this committee shall be the arranging for the scientific papers and discussions and the general programme of the annual meeting.

An adjunct local Committee of Arrangements of three members shall be appointed by the President from Fellows residing at or near the next place of meeting.

The committee shall have authority, by unanimous action, to invite papers to be read and topics to be presented by individuals outside of the Association.

Meetings of this committee shall be held at the call of the Chairman. The Secretary of the Association shall be the Secretary of this committee, and shall keep Minutes of the meetings.

Section X.—Publication Committee.

The Publication Committee shall consist of the Recorder, Secretary, and Treasurer, of which committee the Recorder shall be the Chairman. They shall have charge of the publication of the volume of Transactions, submitting proof copies of all papers and discussions to authors, or to those taking part in the discussions, before their publication. They shall employ a competent stenographer to take reports of all discussions of papers on scientific subjects presented to the Association, and to assist the Secretary in keeping the Minutes of the meetings of the Association, of the Council, and of the Committee on Annual Meeting.

Section XI.—Papers and Reports.

All papers and reports read before the Association shall be delivered to the Recorder at the time of their presentation. If the expense of the publication of any paper shall exceed one hundred dollars the cost of publication may, upon the unanimous vote of the Publication Committee, be subject to assessment upon the author. No paper shall be published in the Transactions which has not been read in full before the Association or presented by title, nor elsewhere reported unless full credit is given to the Association.

Section XII.—Initiation Fee.

Every Fellow shall on admission pay an initiation fee of $50.00, by which act he acknowledges and accepts the Constitution and By-Laws of the Association.

Section XIII.—Annual Dues.

There shall be an annual assessment of $10.00, payable on the first day of the session.

Section XIV.—Arrearage of Fellows.

Any Fellow in arrears for one year, being notified of the fact by the Treasurer in writing, and not paying his dues two months thereafter, shall forfeit his Fellowship, and it shall be the duty of the Treasurer to notify the Association of such forfeiture, which shall be entered on the Minutes and the name stricken from the list of Fellows. The notice aforesaid shall contain a copy of this section.

Section XV.—Invited Guests.

Any Fellow may invite any medical man in good standing to a meeting of the Association, and every such visitor shall be introduced to the President, and by the President to the Association, and his name entered upon the Minutes. The President may invite any such person to participate in the discussions, but all invited guests shall withdraw from the executive session.

Section XVI.—Seal and Certificate of Fellowship.

The Association shall have a distinct seal as well as a certificate of Fellowship, to a copy of which, signed by the President and Secretary, every Fellow shall be entitled.

SECTION XVII.—ORDER OF BUSINESS.

1. Preliminary addresses.
2. Announcements of local Committee of Arrangements.
3. Admission of new Fellows and introduction of invited guests.
4. President's address.
5. Reading of papers.
6. Verbal communications.

Executive Session.

1. Reading of Minutes of last meeting.
2. Appointment of Auditing and Nominating Committees (first day).
3. Reports of the Secretary, Treasurer, and Recorder.
4 Report of Council.
5. Report of Committee on Annual Meeting.
6. Report of Publication Committee.
7. Reports of special committees.
8. Unfinished business.
9. New business.
10. Election of officers (third day).
11. Election of Fellows (third day).
12. Induction of new officers.
13. Adjournment.

SECTION XVIII.—RULES OF ORDER.

The proceedings of the Association shall be conducted under the usual parliamentary rules of order.

SECTION XIX.—ALTERATION IN THE CONSTITUTION AND BY-LAWS.

No part of the Constitution or By-Laws shall be amended, altered, or repealed except at a regular annual meeting. The suggested amendment, alteration, or repeal in the Constitution or By-Laws shall have been presented at a previous annual meeting, signed by three Fellows. The adoption of the suggested amendment, alteration, or repeal shall be by the vote of three-fourths of the Fellows present.

D. Hayes Agnew Memorial Wing, University Hospital, Philadelphia.

THE D. HAYES AGNEW MEMORIAL WING OF THE UNIVERSITY HOSPITAL, PHILADELPHIA.

By De FOREST WILLARD, M.D., Recorder.

[Extract from the Recorder's Report ordered to be published in the Transactions.]

"At our meeting in Washington last year a statue of the founder and former President of this Association, Dr. Samuel D. Gross, was unveiled.

"During the past year a monument equally lasting in character, and more widespread in its beneficial results, has been erected in Philadelphia in honor of another President of this Association—Dr. D. Hayes Agnew, a man whom we all honored in life, and whose memory, now that he has passed to his eternal reward, will thus be kept in active remembrance.

"The monument is one thoroughly in keeping with his practical life. It is in the form of a hospital, which will not only perpetuate his memory but will daily assist toward health one hundred and fifty individuals, making a total of several thousand each year.

"While this monument was not the outcome of official efforts of this Association, yet, since the movement for its erection was inaugurated in 1893 by the Recorder of this Association, and was carried to completion largely by the efforts and contributions of our Fellows, and since at its opening our former President, Dr. Claudius H. Mastin, was appointed to deliver the oration, and addresses were also made by two others of our Fellows, Dr. White and Dr. Willard, it seems fitting that a record of this memorial should be placed in our Transactions.

"The building is erected upon the grounds of the University, where during thirty years of judicious, clear, and forceful teaching, Prof. Agnew influenced and moulded the career of many thousands of students, all of whom were his friends and admirers.

"It contains 150 beds; has three clinical amphitheatres, seating from 125 to 275 students, and is fitted with the latest and best devices for the teaching and performance of thoroughly clean and aseptic American surgery. In many respects it is a model hospital.

"It contains five departments—Children's Orthopædic, General Surgical, Gynecological, Ophthalmological, and Otological—besides dispensaries, laboratories, Roentgen ray and photograph studios, sterilization and instrument-rooms, private patient accommodations, nurses' quarters, special apartments for muscular development, and every needed accessory for the most advanced and scientific surgical work.

"The building has been erected at a cost of $175,000, and is an attractive but not expensive building, considering its large accommodations. Marble and tile have been used wherever necessary to insure cleanliness. In addition to the money expended upon the building, twenty-five beds have already been endowed, and it is hoped that these will be steadily increased.

"Professor Agnew died in 1892, at the ripe age of seventy-four years, honored and beloved by all, and it is believed that this form of Memorial is far more in accord with his life and work than could have been secured by the erection of any statue, no matter how imposing or ornate.

"No member of the profession ever devoted his skill more conscientiously to the benefit of his patients than did Dr. Agnew, and it is most fitting that his unbounded love for God and for his fellow-men, and his great surgical ability, should continue through the coming centuries in the daily beneficence of this

AGNEW MEMORIAL HOSPITAL."

Agnew Memorial, Children's Orthopædic Ward, University Hospital, Philadelphia.

ADDRESS OF WELCOME.

By JOSEPH HOLT, M.D.,
NEW ORLEANS.

Mr. President and Gentlemen, Fellows of the American Surgical Association: I esteem myself particularly honored in having been requested to convey to you, from the medical profession of New Orleans, the assurance of a cordial welcome. Your title enforces a claim to our homage; for we recognize in you the embodiment of American surgery in the glory of its achievements, and in the exhibition of those moral and intellectual graces which command the public confidence and have established the honorable reputation of medicine in America and its fame throughout the world.

You are not as strangers within our gates, for we greet you as kindred with ourselves, members of one family. We rejoice in this opportunity to cultivate a personal acquaintance with those we have long known through their distinguished labors, hoping in the contact to be drawn into a closer relation by those bonds of sympathy and of high regard to which shall be affixed the seal of perpetual friendship.

Nor is this welcome restricted by professional limitation; for the world recognizes the validity of those claims which compel our special allegiance, and accord a universal tribute of honor; it acknowledges the obligation of humanity to the American surgeon.

He needs no eulogium to strengthen his position, already grounded in the necessities and sustained by the gratitude of the people. The eminence of his service as an indispensable agent in the social economy, together with the historical record of his contributions to science in the conservation of life and the amelioration of suffering, are sufficient claims upon the rational judgment and the justice of his fellow-men fairly to award him the honor he has won. The facts of his achievement constitute the pedestal upon which his laurels rest.

To recount these facts, giving in outline merely the name, the date,

the character of work, and the beneficent results, would consume not only the entire time allotted to an address of welcome, but would require hours of descriptive and statistical display. Even with this great effort we would fail to bring to date the work now going on.

An exhaustive examination of the accumulated work of American physicians and surgeons would richly justify the seeming exuberance of a distinguished writer, Dr. Frederic S. Dennis, when he declared that "Our contributions to medicine and surgery in general are now matters of record for the study of all nations. If what Americans have accomplished be eliminated from the sum total of the surgical work of the world, there is little left to the other nations."

This is a bold but not an exaggerated reply of the present to the past, not many decades ago, when Sidney Smith, in the *Edinburgh Review*, 1820, while we were in the feebleness of national childhood, rather contemptuously, but truthfully, said: "Americans have done absolutely nothing for the sciences. In the four corners of the globe who reads an American book? What does the world yet owe to American physicians or surgeons?" Could Sidney Smith return to-day he might busily occupy a good, long lifetime in reading American books in the Congressional Library; in a course of technology in the Patent Office Department and in the Smithsonian Institute; and of medicine and surgery in the Army Medical Museum; and finally be buried in Washington, having never gone outside of that one city, and having never overtaken the procession of current events.

Dr. Austin Flint, in an address before the American Medical Association, said:

"When one is able to call up at random the discoveries in gastric digestion, anæsthesia in surgery and obstetrics, the successful deligation of the arteria innominata, the operation of vesico-vaginal fistula, ovariotomy and intestinal anastomosis, to say nothing of minor advances in medicine and surgery, can we not claim a distinctive place for American medicine? It is in the United States that advances in the science of medicine find the most ready acceptance and appreciation. The American physician is the most intelligent and judicious therapeutist, and in the United States are the best and safest surgeons and gynecologists."

These are authoritative opinions, in emphatic denial of those pretensions which too often gloss a foreign diploma. They give a merited rebuke to a pitiable vanity which has sought in schools abroad and in foreign treatment the *éclat* of high-sounding names and distant places,

rather than superior advantages in practical efficiency and operative skill offered at home in our splendidly-equipped and modernized centres of medical education.

In times past this yearning for a foreign diploma as next best to a foreign title, betraying a smallness of spirit and a childish vanity almost despicable and wholly un-American, was almost the rule, but is now an exception; for even with the weakest worshippers of the glittering tinsel which adorns foreign titles and honors, the centre of attraction has been shifted from abroad and localized in our home institutions, not by a patriotic sentiment, but by the law of natural selection in favor of the fittest, which, not always, but in this instance, is also the best.

While recognizing the advantages of travel and, when convenient, of a course of post-graduate observation abroad, in the enlargement of one's views and as a source of satisfaction in personal experience, we are justified in declaring that in the whole range of medicine in general, and in all of its branches as specialties, there is no subject that is not as thoroughly taught, and a knowledge of which may not be as perfectly acquired in the United States as in the most renowned hospitals and schools in the world.

There is better reason why the foreign gynecologist and student in other departments of conservative surgery and preventive or State medicine should put the finishing touches to his professional fitness by taking a post-graduate course in the American schools of iconoclasm, innovation, and progress. Such a course would improve him in dexterity, self-confidence, and the details of technique; it would confer a freer latitude of thought and of action, somewhat easing him of an inherited burden of tradition and the pernicious restrictions of a lifelong discipline, constraining him to swear in the words of his master, subservient to precedent. As said by Prof. Edward H. Clarke: "The flexibility of the American method permits of change, growth, and development in correspondence with the demands of each succeeding age, more easily and more rapidly than is possible with the conservative organizations of Europe."

We may bravely challenge comparisons, for, however pitiable the feebleness of science and of art in the days when we lived in a wilderness, waging war with nature in her savagery, in the times when our universities were old-field schools, we can proudly say of medicine in America that it has developed in normal proportion, head and front with every other branch of physical science applied in art. It is

coextensive with all the other developments and accessories of these seventy millions of citizens, whose wealth and power, acquired through applied knowledge, transcend the limit, almost, of comprehension and belief. If the collective energy of this country has accomplished such a vast work against such obstacles and in so short a time, what may we predict of the future?

Your work is a part of this general content, of this huge and complex aggregate, to which it bears a proportionate and an indispensable relation; but how is it that the word "American" with an excluding signification, has been adopted as the qualifying term in the name of your Association? With a membership organically limited to one hundred, why has this Association "corralled," so to speak, a term that may be claimed as the birthright of every medical man on two continents, North and South, including the isthmus?

For reasons of etiquette, a full and satisfactory reply could hardly emanate from yourselves, but must be furnished by your brethren, outside the pale of your association fellowship, who proudly recognize you as a representative body, justly entitled to the name you bear.

As citizens of the United States, you have assumed this title of "American Surgical Association" to the exclusion of Canada, Mexico, Central and South America, and you hold it by a prescriptive right of usage at home and abroad, and certainly as a conceded privilege. It was originally acquired by pre-emptor's claim, purchased with the blood and treasure of successful revolution.

The name was chosen for identification, with the idea alone of geographical and national limitation, and with no assumption of superiority or the possession of exceptional merit.

In addition to an inherited right through citizenship and acquiescence, the American surgeon can offer claims to this eminent distinction, scientific and technical, in keeping with all else that has come within reach of the omnivorous digestion and of the assimilative and constructive processes of the American mind. For, whatever may be said of the sameness of science throughout Christendom—as, for example, in the study of anatomy, physiology, and the principles of medicine—this is not true in its application to art, which is influenced and powerfully modified by race character, by natural and social environment, by example and the habit of repetition, and by that indefinable prevalence or fashion in opinion and thought called "the spirit of the age." Through the physiological action of these combined agencies, we see both science and art, in government, in

law, medicine, manufacture, agriculture, and whatever else, digested, assimilated, and reorganized; ground down, synthetized, and evolved in the spiritual likeness, and bearing the stamp of the mental constitution and idiosyncrasies which determine and at the same time differentiate civilization among the peoples of the globe.

In order to discover whence these traits and special gifts; the self-reliant and well-poised mind, with quickness of apprehension; the persistent energy and patient labor toward predetermined results; the individualism in thought and freedom in action, particularly in the inventive adaptation of methods to a purpose, which seem an inherent store of unlimited resource in the American; to account for these, we must delve into the antiquities of his ancestral origin, and follow the line of his family history in Northwestern Europe and the British Isles. While including later the Scotch and Irish, we must go back to the Teutonic, and especially to the Dutch origin of the most of our ancestors, to find the energizing source of that potential agent, the "tertium quid" or indefinable third quantity, that spiritual something, which, in the race, under its environments, has wrought through evolution the amazing exhibition of the English-speaking people—*sui-generis* in the relations of their domestic life, out of which have grown their civil polity and their supremacy among the powers.

Speaking in terms of the naturalist, we may say that every distinguishing mark we suppose to be peculiarly American is derived by hereditary transmission of primitive race traits, working through posterity, along lines of adaptation and of natural selection. Preserving ethnological purity as an ethical instinct in our contact with the lower races, and, therefore, race dominance, we have developed and overspread islands and continents, always in the direction of greatest possibilities; albeit, sometimes of greatest resistance. What we call our Americanism withstood the power of Rome for five hundred years, and was finally victorious. The same qualities in race character rallied the Germanic forces at Poitiers, and rolled back beyond the Pyrenees the tide of Asiatic invasion, saving Christian Europe from Oriental degradation and Islamism. We did not supplement, but supplanted, the Britons; and on this continent we did not commingle with, but wiped out, the incorrigible Indian, and extinguished the pretensions of France and Spain.

Our theory of constitutional government emanating from the people as the source of power, the framework of our judicial system, based upon fundamental notions of the rights of man guaranteed

under law, and insuring freedom of speech, freedom of action consistent with the rights of others, freedom of the press, and "the free exercise of religion according to the dictates of conscience," divorcing religion from politics, church from state, by asserting the right of personal judgment; all of these were rudimentary but distinctly manifest in the primal Germanic character, in the ancestral antecedent of which we are the consequent. Out of these beginnings have grown our English institutions, which have made the English-speaking people the foremost of the world.

The unrestrained expansion of philosophy, science, and art, with the rich blessings of material prosperity which flow from them, are the fruits of those organic principles in the character of our barbaric progenitors, whose distinguishing trait was the individualism and independence of the citizen.

From such a source, and moving through the channel of hereditary transmission under the law of evolution, it is no wonder that the medical profession in America began to achieve independence coordinately with that of the Colonies. No wonder that such men as the Warrens of Boston, Benjamin Rush, Philip Sing Physick, John Syng Dorsey, and G. W. Norris, of Philadelphia, Benjamin W. Dudley, of Virginia, and Valentine Mott, of New York, J. Kearney Rodgers, Dixie Crosby, and a host of like celebrities, remarkable for wisdom, largeness of acquirement, accuracy in judgment, originality, and decision in action—no wonder, we say, that these names are to-day the glory of American surgery.

Recognizing in our history the operation of this law, as universal as the movement of creation, we may account for the amazing spectacle of Ephraim McDowell, a village doctor in the Western wilderness, working out through his own inventive suggestion the profoundest problem in operative surgery, and, finally, mastered by the power of his convictions, and facing his own death as the penalty of failure to save the life of a patient, already hopeless in the nature of her malady, according to all experience of such cases at the time, he boldly cut into the human abdomen, from whence removing a huge tumor, he saved his patient, and hundreds of thousands of patients, by adding the vast field of abdominal operations to the domain of conservative surgery. It is befitting that humanity has declared its gratitude, in the erection of a monument worthy of his memory, and in praises throughout the world.

But how can the world pay its debt to Morton, Wells, and Jack-

son, of Massachusetts—all of whom died in poverty and wretchedness —and to Long, of Georgia; to those men who worked out another mighty problem, wherein they o'erleaped the limits of audacity by invoking the similitude of death to annul the agony of surgery. These bold innovators, themselves swallowed up in the anguish of misfortune, gave to humanity a balm richer than nepenthe, for anæsthesia annihilates pain as well as grief, and calms all terrors.

Thus it occurs that laparotomy and anæsthesia, two American contributions, gave a tremendous impulse to medicine; but there remained a crowning glory, which was to confer upon surgery the title and dignity of an established science, whose results could be forecasted accurately.

It has been said that the discovery of anæsthesia marked the division between the old and the new; between the ancient—of about fifty-five years ago, for concrete surgery is scarcely a century of age—and the modern; but, in truth, the dividing line between the hap-hazard desperation of the past and the confident assurance in the conservatism of the present, this culminating moment connecting two epochs, was declared by a ceremony, closing the old dispensation and opening the new, in the marriage of Æsculapius to Hygeia—of Surgery to Sanitation—about twenty-three years ago.

In this blessed union the science of medicine was lifted from a low estate by the recognition of a universal and pervasive law, emanating from the infinite perfection of God, and governing with equal application and intensity in the spiritual and in the material life—the law of absolute cleanliness. By this revelation medicine was established upon an exalted plane, in unbroken continuity with morality and religion. It was obedience to this law that made all things possible in surgery and vouchsafed the benefit to man.

Pressing beyond the antisepsis of Pasteur and of Lister, it remained for the American surgeon to project the final advance upward to a complete and absolute asepsis or immaculate purity. Not merely the cleansing of that which is infected and already dominated by sepsis, the maternal analogue of sin; but the methodical guarding against and prevention of sepsis by an implicit obedience in conformity with, and, therefore, acceptable to the law itself. For the law, being immutable, will not turn aside to make amends for ignorance or sloth, but demands an absolute satisfaction, called justice, and appoints the way. Thus it is, no man can prescribe for himself the methods of his effectual cleansing, in body or in soul, but must conform himself to the neces-

sities of his being, as a creature under law, submissive to its remedial guidance.

However plain may be this statement as a self-evident proposition, it has been a hard struggle to put aside the old and accept the new; to break through the crystallization of matured opinions, hallowed by early association, and to abandon methods firmly grooved into the ruts of routine by habit.

However easy in the light of the present, it was an effort of revolution to adopt the innovations of physical science, those valid inductions from observed facts in nature as opposed to established dogma and speculative medicine. The whole bacteriological scheme was denounced as heresy and scouted with contempt. Its opponent of the old school was opinionated, recalcitrant, and surgically unclean, but proud. Like Naaman, the leper, he turned away in a rage, and said: "Are not Abana and Pharpar, rivers of Damascus, better than all the waters of Israel? May I not wash in them and be clean?" May I not observe my accustomed formulas sanctioned by the books? No, sir! Away with your formulas and the sanctions of your philosophy, when these become shackles upon independent inquiry, obstructing the higher obedience, which may demand that you shall "Go and wash in Jordan seven times," according to the saying of the man of God, the scientist, who interprets his law.

These are not picturings of the imagination, but absolute truths of the larger law through which the power and dignity of medicine are mightily extended in the direction of its highest aims.

Moreover, the aseptic "instinct," or, better, the innate idea of asepsis as an *à priori* element of reason, must be born with a man, *ab initio*, or he must be born again, into it, by a regeneration of his natural instincts, which are contaminating and infective. Some are born dead to the aseptic "instinct," and can never acquire it. Outlawed by nature, they are incorrigible, unclean; let them alone, "and he which is filthy let him be filthy still."

In all this matter is not preventive medicine, or asepticism, a most evident symbol and, in substance, a type of that which is correspondent in the spiritual man, and archetypal in the essence of deity? How truly may the surgeon, in contemplating the exactions imposed by hygienic law, exclaim, in the language of Scripture: "What is man that he should be clean," and he which is born of a woman that he should be righteous?

Behold, he putteth no trust in his saints; yea, the heavens are

not clean in his sight. How much more abominable and filthy is man!

Hopeless, indeed, would be the task of the surgeon but for the counter-assurance, "Thou madest him to have dominion over the works of thy hands; thou hast put all things under his feet."

Strange it is that the superb intelligence marshalled in the ranks of medicine has so lately discovered the continuity or unity of all law as eternal and unchangeable as the personal First Cause is infinite in wisdom and power.

Enjoying the autonomy of free will, this intelligence has attempted to supply from the stores of philosophical assumption, first a fetichism, and later a tissue of cunningly-devised theories, for the ignored facts of nature, and wherewith it has prescribed for itself.

As an able writer has said of Cullen: "Reasoning from *à priori* considerations, he founded his pathology and nosology upon pure theory. He declared it to be the duty of a philosophical inquirer in medicine to control his observations by his theories, and not his theories by his observations. In like manner he maintained that the medical practitioner should be guided at the bedside less by the indications of nature than by theoretical considerations." A father in medicine assuming to control nature by a self-originated fiat outside of and superior to natural law!

Thus it is that truth has been sedulously veiled, while theory, empiricism and authority have ruled the medical world.

But time admonishes me to desist from a further consideration of this subject, perhaps already too extended; if so, my apology is in the magnitude and fascination of the theme: "The American Surgeon."

From our hearts you are welcomed, gentlemen, to our city, this old and unique gateway of the Mississippi Valley to the sea; to the sometime home of Charles A. Luzenberg, Warren Stone, Erasmus D. Fenner, E. H. Barton, Samuel Choppin, Samuel M. Bemiss, T. G. Richardson, Samuel Logan, Albert Miles, of Andrew W. Smythe, living abroad, and of their successors, able and worthy to wear the mantles of their predecessors and to do mightier works than they.

ADDRESS OF THE PRESIDENT,

THEODORE F. PREWITT, M.D.,
ST. LOUIS.

Fellows of the American Surgical Association: We meet again in annual session to promote the interests of this Association and of surgery, and the Chair extends you a cordial greeting with the earnest hope that the coming session may be harmonious and fruitful of good work.

I avail myself of the first opportunity offered to return my profound thanks for the honor conferred upon me in electing me your presiding officer for the past year. The brilliant array of distinguished surgeons who have preceded me, from the peerless Gross to the scholarly Warren, have added lustre and dignity to this position. I enter upon its duties with some diffidence and some misgivings as to the fitness of the choice your kindness dictated. I fully realize, however, that the honor was not intended for me alone, but for the great West, which I in part represent.

In accordance with the custom which imposes upon the President the duty of addressing the Association upon some subject of his own choosing, I have elected to speak of the "Future of the Association."

The past speaks for itself. It is a record of which we all feel proud. The proceedings of this Association receive respectful consideration wherever in the civilized world the science and art of surgery are cultivated. They have left their impress upon the teachings of surgery.

The American Surgical Association had a distinct purpose in its formation. Its distinguished founder, in its organization

had in mind something grander and more far-reaching than the mere building up of a surgical society. There were numbers of these already in existence, amply sufficient to give expansion to the aspirations of the restless, ardent spirits of the profession who were ambitious to enter the field as essayists, etc. He felt that there were needed men of sober judgment and ripe experience, whose deliberations and whose dicta would carry weight wherever disseminated, a national organization representative of American surgery, that should compare creditably with similar organizations abroad.

Into this Association he threw his whole soul. It was the child of his old age. He looked forward to the association of his name with its growth and perpetuity as, in a certain sense, a monument to himself and his labors in behalf of surgery. He hoped, like Horace, to have erected a monument more lasting than brass.

I well remember when, at a banquet at Cincinnati after he had declined a re-election to the presidency of the Association, in addressing the Fellows present, he said, in a voice trembling with emotion when referring to his retirement, "And when I die, as soon I must, I leave its welfare in your keeping."

He seemed to have suddenly realized that a link in the chain of life had been severed. Perchance, the depression of spirit incident to this thought may have served as a factor in hastening the end he had so pathetically foretold.

Be that as it may, we should not prove recreant to the trust reposed in us: to guard sacredly the highest interests of this Association. In every step taken by us its perpetuity and usefulness should be considered. It behooves us, therefore, to consider seriously whether we have not at times lost sight of this high purpose.

I would not lower by a hair's breadth the standard of excellence established as requisite for admission to Fellowship in the Association. The postulant should not only be a good surgeon, of ripe experience and a demonstrated ability to contribute to the advancement of surgery, but we may justly give consideration to

the social and personal characteristics of the individual as well. The self-laudatory egotist who seeks, after the manner of the charlatan, to impress upon an unenlightened and gullible public his superiority to all others, who covets the notoriety which the frequent appearance of his name in the public press may bring, must ever be a *persona non grata* to a body of men whose strongest motives are a love of their profession, and whose higest aim is its advancement.

Conceding all this, are there not others in this broad land with all these requirements we might cordially welcome to our ranks? Can we claim to have monopolized all of the distinguished talent of the profession, all who might add lustre to American surgery?

In our dealing with this question have we always kept in view the best interests of surgery in general and this Association in particular? Certainly the action of the Association has at times seemed inexplicable, and I may add mortifying to many Fellows, while it has savored of injustice to some whose record has been without reproach and whose work has been most creditable.

The very assumption of the name "American Surgical Association" carries with it responsibilities which we cannot properly ignore. Every Fellow will agree with me that it must not be allowed to degenerate into an organization dominated by selfish purposes. These considerations suggest a revision of the methods of adding to our numbers.

Any action that would antagonize the great body of professional men would seem to me unwise. Admission to its membership should be a recognition of merit which should stimulate younger men to look forward to that end, as the desired goal of an honorable and praiseworthy ambition.

Let the fellowship be as broad as the imperial domain its title represents, and generous enough to embrace the choicest spirits in the whole profession.

The open sesame should be: Is he honest? Is he capable? Has he won a standing in his profession which warrants admission to fellowship in the most distinguished body of surgeons in the

United States? If so, all rivalries and jealousies upon the part of individual members should be silent.

To avoid the unpleasant happenings of the past, it seems to me imperative to so alter our constitution and by-laws as to require a larger number of negative votes to prevent an election. Great surgeons are not free from the foibles and weaknesses of human nature, and the feelings engendered by rivalry in one case mingled with a little latent jealousy, perchance, and a stinging resentment over the defeat of a friend in another, may serve to cause the rejection of excellent men. The poet's instinct struck the keynote of human nature when he said, "Where self the wavering balance shakes, 'tis rarely right adjusted."

Pardon the implication. I would be loath to intimate that any member of this Association has been influenced by such motives, or would be in the future. Nevertheless, it seems to me that it would be wise to establish a less narrow margin than now exists upon the admission of new members.

The future of this Association, if we may judge of it by the past, should be a brilliant one. The reviewer of the progress of our art fifty years from now, in looking backward will doubtless find in the records of this Association the most complete and ablest discussions of every subject in the whole field of surgery. The kaleidoscopic changes which new discoveries, new investigations, and new technique will have brought about will have been accurately recorded, and from its rich stores will have been gleaned much of the authoritative statements that will make up the bulk of the text-books and essays issued by the medical press of that day. Is not such a record one that we may contemplate with profound satisfaction and pride? Is it not our duty to contribute to this end?

The sunset of the nineteenth century is illumined by the splendor of its own achievements, and challanges the future to equal or eclipse its record.

There is scarcely a feature of the civilization, the comfort, and the convenience of the present day that is not the product of the last three-fourths of the century. Railroads, steamboats,

telegraph, telephone, photograph, electric light, electric motor, with many other marvellous things, have made this century the most brilliant epoch in the world's history.

We are proud to say that medicine and surgery have not been laggards in this phenomenal procession of wonderful achievements. Within the period named they have leaped from a crude empiricism to a status closely approaching exact science. Will the twentieth century find them keeping abreast of the advances made in the material world? Will surgery advance with strides commensurate with those of the past fifty years?

If so, the American Surgical Association, representing as it does the vanguard of American surgery, will need the cordial and earnest co-operation of all the distinguished surgical practitioners, writers, and teachers of this whole country, if it would occupy the proud position its founders destined for it.

THE ETIOLOGY AND CLASSIFICATION OF CYSTITIS.

By N. SENN, M.D.,
CHICAGO.

The bladder is the dilated portion of the urinary tract interposed between the ureters and the urethra, and in a normal condition serves as a temporary reservoir for the urine. It is composed, like all receptacles of this kind, of three anatomically and physiologically distinct coats: 1. Mucous coat; 2. Muscular coat, and 3. Peritoneal coat. The mucous coat differs from the structures of this kind as found in most other organs in that it contains no glandular appendages. The mucous membrane of the urinary bladder is devoid of glands, and is made up of several layers of squamous epithelium. The fibres of the muscular coat are arranged in such a manner that when they contract, the organ being in a normal physiological condition, complete evacuation of its contents takes place, while during the intervals between urination they permit insensible painless distention to the physiological limits. The serous coat, like all peritoneal investments of other abdominal organs, is admirably adapted to insure free mobility of the organ in the performance of its complicated functions. The bladder is freely supplied with bloodvessels, which take such an important part in all inflammatory processes. The lymphatic vessels are found only in the muscular coat, and play an important *rôle* in the pathology of interstitial cystitis and in the extension of infective processes to and from the bladder.

ABSORPTION FROM THE BLADDER.

In the study of inflammatory affections of the bladder it is important to obtain a clear conception of the function of its

mucous lining. The epithelial lining of the bladder is not, properly speaking, a mucous membrane, as it is not supplied with glands, and in a normal state secretes no mucus. It is the reservoir for an excretion and not for a secretion. For this, if for no other reason, we would *à priori* question its ability to absorb medicinal and toxic substances. The mucosa of the bladder contains no lymphatics; it lacks, therefore, all the physiological elements necessary for absorption. Gerota,[1] in the examination of more than sixty bladders, could not demonstrate, either macroscopically or microscopically, the presence of lymphatic vessels belonging to the mucous membrane. None could be detected in the trigonum. The few vessels found in the submucosa of the vesical neck were identified as the lymphatics of the urethra, which extend for a short distance into the neck of the bladder, but soon enter into the muscular coat.

That the normal mucous membrane of the bladder is not an absorbing surface has been demonstrated by the clinical observations of Civiale and many other surgeons and the experimental work of many investigators, among them Kuss, Susiné, Alapy, Alling, Lewin and Goldschmidt, Cazeneuve, and Livou.

Guyon is of the opinion that the vesical mucous membrane lacks the function to absorb, while Bazy and Sabatier are of the opposite belief.

Hottinger's[2] experiments seem to prove that enormous quantities of poison must be introduced into the bladder of animals to produce death. Death in such cases he attributes to a process of diffusion rather than absorption.

Lewin and Goldschmidt[3] made many experiments on animals, and came to the conclusion that the healthy mucous membrane of the bladder is impermeable to toxic substances, and when absorption does take place it is from the prostatic portion. Their experiments were made by ligating the neck of the bladder

[1] Anatomische Anzeiger, Band xii. p. 347.

[2] "Zur Frage der Absorptionsfähigkeit der gesunden Harnblase." Centralblatt f. die Krankheiten der Harn- und Sexual-Organe, Band vii. Heft 5.

[3] "Die Resorption körperfremden Stoffen aus der Harnblase." Archiv f. experimentelle Pathologie, December 30, 1895.

and injecting the solution directly into the bladder through an abdominal incision.

Alapy[1] experimented with strychnine and obtained very variable results. With a view of explaining these differences in the results, he made a further series of experiments with cyanide of potassium. All of the animals thus treated died. He concluded from his experiments that when a non-volatile poison is used and the results are not constant, the positive results followed the absorption of the poison from the prostatic portion, while no absorption occurred from the vesical mucous membrane, and that death resulted in those male animals in which the poison escaped from the bladder through the urethra.

Recently Ashdown has succeeded in killing rabbits by injecting poisonous substances into the bladder.

Bazy and Mazon, from repetition of the same experiments, came to the conclusion that poisonous substances in solution are absorbed by the intact vesical mucous membrane. It is more than possible that in these experiments absorption took place not from the mucous membrane of the bladder, but by the escape of fluid into and absorption from the urethra. From a practical stand-point it is safe to assume that the intact mucous membrane of the bladder is a non-absorbing surface, and that when absorption does take place it is in consequence of injuries and lesions which open up avenues for the entrance of toxic and infective substances into the lymphatics or blood-vessels of the middle coat.

A rational discussion of the diagnosis, prognosis, and treatment of cystitis must be based almost entirely on what we know concerning the etiology and classification of this very variable and obstinate disease. I have deemed it expedient and advisable to limit my remarks on this occasion to the etiology and classification of cystitis, with the expectation that it may serve the purpose of preparing the way for a more general and thorough discussion of the more purely surgical aspects of this disease at our next or some subsequent meeting.

[1] "Ueber das Absorptionsvermögen der Harnblase." Centralblatt f. die Krankheiten der Harn- und Sexual-Organe, 1895, Band vi. Heft. 4 and 5.

I. Etiology of Cystitis.

The recent great advancements in the prevention and more successful treatment of infective surgical diseases are the direct outcome of the vast increase of our knowledge concerning their etiology. Surgical bacteriology paved the way for rational surgery. It is now very generally conceded that inflammation of any tissue or organ is invariably caused by microbic invasion, and that all other causes only act by determining or favoring infection. If this be true it is apparent that the successful treatment of cystitis presupposes an accurate knowledge of the nature of the microbic origin of the inflammation. Suppurative cystitis and tubercular cystitis are so entirely different in the nature of their bacteriologic origin that the method of treatment successful in one would almost with certainty aggravate the other. Inflammation of the bladder is often the result of a mixed infection, and it is of paramount importance in all such cases to gain accurate information by bacteriologic examination of the urine concerning the part which each kind of microbe plays in the causation and continuance of the inflammatory lesion before an intelligent and successful course of treatment can be devised and carried into effect. It is of special importance in the successful management of cystitis and conditions mimicking cystitis clinically to make a sharp distinction between the cases in which the symptoms are caused by inflammation and those in which they are due to non-inflammatory pathological conditions. It will be seen from these remarks that the modern etiologic study of cystitis is based largely on a carefully conducted bacteriologic examination of the urine. The exercise of patience and perseverance is often required, as in many cases the urine has to be examined repeatedly before the necessary information is gained.

1. Predisposing Causes. In our old text-books we find in the discussion of the etiology of disease the familiar distinction made between predisposing and exciting causes. In our modern literature we find all the exciting causes discussed under the head of predisposing causes, and the list of exciting causes

is an entirely new one, containing terms unknown to medical and surgical writers of more than fifty years ago. As predisposing causes of cystitis we recognize and describe such injuries, agencies, and influences as are concerned in establishing a *locus minoris resistentiæ* in the tissues of the bladder in which a sufficient number of pathogenic microbes of adequate virulence accumulate to produce those tissue changes which characterize inflammation. The injured tissues or contents of the bladder furnish the necessary nutrient medium in which the microbes grow and multiply. All of the predisposing causes do one of two things or both: 1. They effect tissue changes which determine the localization of microbes from the bladder, adjacent organs, or the general circulation. 2. They furnish a nutrient medium for the growth and multiplication of microbes.

Retention of Urine. The most frequent of all predisposing causes of cystitis is retention of urine from any cause. Retention of urine acts in two ways in predisposing the bladder to infection: 1. The retained urine serves as a culture medium for some of the microbes which are known to produce cystitis. 2. The distended bladder wall is subjected to pressure, which in itself is a potent predisposing influence.

Mesnil de Rochemont[1] made experiments with a view of demonstrating that the presence of pathogenic bacteria in the bladder is not sufficient to produce cystitis, but that a second factor is necessary to induce inflammation, which he has found in a predisposition in the bladder wall. He made a bacteriologic examination of the urine in twenty-five cases of cystitis. The urine was removed from the bladder under strict aseptic precautions. From these cases he cultivated from the urine fourteen different kinds of microbes. Of these microbes nine species were facultative anaërobic and five obligate aërobic. One-half of them decomposed the urea; the remaining half had no such effect. With the exception of one, all proved pyogenic in the animals experimented upon. He found that sterile foreign bodies inserted into the bladder and causing no obstruction

[1] "Zur Pathogenese der Blasenentzündung," Leipzig, 1896.

never produced inflammation of the mucous membrane. The experiments with pure cultures were made by introducing the microbes into the bladder from above. His experiments also proved that the presence in the bladder of obligate anaërobic or facultative anaërobic microbes did not produce cystitis, whether they did or did not decompose the urine. If, however, the urethra was obstructed at the neck of the bladder for twenty-four hours, and the urine accumulated during this time, the presence of facultative anaërobic microbes, regardless of their effect on urea, caused cystitis, the urine remaining acid; while the presence of obligate anaërobic microbes, on the other hand, which produced at the same time urea decomposition, inserted into the bladder under the same conditions, caused ammoniacal suppurative cystitis. A temporary obstruction of the urethra without infection of the bladder, according to duration, produced hyperæmia, hemorrhages, and even necrosis.

The local effect of the toxic and irritating substances formed by the action of some of the microbes on the urea of the retained or residual urine constitutes an additional element in the causation and propagation of inflammatory processes in the bladder. The gravest cases of cystitis occur in patients suffering from acute retention of urine in the event the bladder becomes infected, by careless catheterization or otherwise. It is in such instances, more especially if the bladder is at the same time paralyzed, that the inflammation attacks almost from the very beginning the whole surface of the mucous membrane, and is so prone to extend along the ureters to the pelves of the kidneys. In cases of gradually increasing obstruction to the free outflow of urine, so frequently seen in neglected cases of stricture of the urethra and prostatic patients, the residual urine plays an important *rôle* in the origin and extension of inflammatory affections of the bladder. It is in cases of cystitis with such a mode of origin that the trigonum of the bladder is almost constantly the starting-point of the infection and the inflammation following it. It is time that the medical profession should realize the well-known clinical fact that retention of urine is one of the most frequent and potent conditions in

increasing the receptivity of the bladder to infection, and that cystitis can be most effectively guarded against by preventing the accumulation of urine in the bladder beyond the physiological limits. Knowing the great susceptibility of the bladder to infection when the urine is retained, it becomes the surgeon's duty to employ the strictest aseptic precautions in the evacuation of the organ by catheterization, puncture, or incision.

Unrest of the Bladder. Abnormally increased muscular action of the bladder, as occurs in cases of central or peripheral irritation of the nerves which preside over the muscular structure of this organ, or in consequence of the action of local irritants, as stone, foreign substances, tumors, chemical or toxic substances, is a recognized predisposing cause of inflammation of the bladder. The same can be said of reflex influences from adjacent organs, which exert a similar influence in increasing beyond the physiological requirements the function of the muscular fibres. Exaggerated muscular contractions of the bladder favor infection by the vascular changes which they produce, and especially by inducing the surgeon so often to resort to unnecessary harmful instrumental examination.

Abnormal Urine. Abnormal conditions affecting the quality or quantity of urine frequently precede inflammation of the bladder, and must be regarded in the light of predisposing causes. Hyperacidity and, more frequently, alkalinity of the urine, by causing congestion of the vesical mucous membrane and by disturbing the function of the bladder, furnish the conditions for a subsequent infection. Albuminuria, polyuria, and especially diabetes, appear to increase the susceptibility of the bladder to infection. The elimination through the urine of irritants, such as cantharides, turpentine, and allied drugs, and the irritating principles of certain articles of food and certain alcoholic beverages, produce alterations in the mucous membrane of the bladder which prepare the tissues for infection and inflammation.

Tumors. Tumors of the bladder, malignant and benign, frequently precede and complicate cystitis. Vesical tumors may prepare the bladder in different ways for infection. They may

cause retention of urine, vesical tenesmus, hemorrhage into the bladder, and, in the event of ulceration, the urine comes in contact with an abnormal surface, all conditions of which would be favorable to infection. Again, tumors of the bladder are productive of symptoms which lead the surgeon often to explore its interior by the use of instruments, a method of examination to which the date of infection can frequently be traced

Calculus and Foreign Bodies. The presence of a stone in the bladder is attended by symptoms which point to inflammation of the neck of the bladder minus the evidences revealed by a microscopic examination of the urine. It has been shown experimentally that the presence of foreign bodies in the bladder never produces inflammation independently of pathogenic microbes. A calculus or a foreign body becomes a predisposing cause of cystitis by the production of local lesions and vascular changes favorable to the localization and growth of bacteria, which are the essential causes of the inflammation. It is well known that a stone can remain in the bladder for years without causing cystitis, and the cystitis which so often complicates such cases can, in the majority of cases, be traced to instrumental examination.

Pressure. Compression of the bladder from within and from without is a potent predisposing cause of cystitis. Pressure from either direction diminishes the vascularity and nutrition of the bladder-wall, and in that way increases the susceptibility of the tissues to invasion by disease-producing micro-organisms. This predisposing cause is most frequently met with in connection with cystitis in pregnant and puerperal women and in cases of myofibroma of the uterus, in which the tumor makes pressure against the bladder. It is in such instances that the infection is likely to extend from the surface to the underlying connective tissue, and that the subsequent inflammation often terminates in extensive exfoliation. An enlarged prostate may encroach sufficiently upon the bladder to cause pressure to a requisite degree to become a predisposing cause aside of the secondary lesions resulting from the chronic obstruction.

Exposure to Cold. Sudden chilling of the surface of the body

results in congestion of internal organs, which occasionally affects the bladder sufficiently to effect vascular changes which determine an infection which otherwise would not have occurred. The embarrassed circulation in the vessels of the bladder is then to be considered as the direct cause of the localization of pathogenic microbes in this organ sufficient in quantity and virulence to produce an inflammation. In the absence of microbes in the bladder, adjacent organs, or the general circulation, no amount of exposure to cold could cause a cystitis.

Venous Stasis. We have already mentioned as local predisposing causes of cystitis conditions which produce congestion, and have regarded them as predisposing causes. Venous stasis in the vessels of the bladder from more distant causes acts in a similar manner, and is followed by the same results. Among such remote causes which disturb the circulation in the vessels of the mucous membrane of the bladder must be mentioned general enfeeblement of the circulation from different debilitating causes, organic heart-disease, consolidation or compression of the lungs, and cirrhosis of the liver.

Trauma. To trauma has been assigned for centuries a direct influence in the causation of cystitis. Since it has been made clear that no inflammation is possible without infection, trauma has been transferred to the list of predisposing causes in the etiology of inflammation of the bladder as well as of any other organ. Trauma of the bladder from injury, the presence of foreign substances, or the action of chemical, toxic, or thermal influences creates a *locus minoris resistentiæ* for the localization of pathogenic microbes, or opens a pathway for their entrance from the bladder into the tissues composing the bladder-wall. Considered in this light, trauma in its various forms constitutes an important element in the causation of cystitis. The injection or instillation into the bladder of caustic solutions strong enough to damage the epithelial lining of the bladder has often provoked a cystitis which, without such therapeutic intervention, never would have occurred. The trauma inflicted by the passage of instruments into the bladder in search of stone or

foreign bodies has undoubtedly been often responsible for similar disastrous results. Operations upon the bladder by either the suprapubic or perineal route have occasionally been followed by septic cystitis from infection during or after the operation, when the interior of the bladder before the operative intervention was in an aseptic condition. Contusion or laceration of the bladder resulting from the application of force from without or within never gives rise to cystitis unless the accident is followed by infection, either by the introduction of microbes by catheterization or the localization of microbes from the blood in the parts injured.

2. Exciting Causes. The essential or exciting cause of cystitis is invariably the presence and pathogenic action of microbes in the tissues of the bladder, the seat of inflammation. In the study of the etiology of cystitis it is important to consider in detail the routes of infection. From a practical standpoint it is well to admit that pathogenic microbes reach the interior of the bladder most frequently through the urethra by the use of instruments, spontaneously, or by the extension of infective processes from the mucous membrane of the urethra to that of the bladder by continuity of surface. It is, however, well to remember that microbes may and do reach the bladder by other routes—namely, through the urine from the kidney, the general circulation, and adjacent infected organs through the lymphatic channels. The study of the etiologic relationship of bacteria to cystitis dates back a little more than ten years, and during this time sufficient proof has been accumulated to show that inflammation of the bladder is always the result of bacterial invasion. It was soon found that the disease may be produced by any microbe which possesses pyogenic properties.

Bumm[1] first made use of Koch's plate cultures in making bacteriological examination of eight cases of cystitis occurring in puerperal women. He found a diplococcus in all the specimens examined, associated in some of them with the gono-

[1] "Die Aetiologie des puerperalen Blasenkatarrhes." First Congress of the German Gynecological Society, Munich, 1886.

coccus or the staphylococcus pyogenes aureus. The microbes cultivated from the urine were also found in the lochia, which led him to conclude that the cystitis was caused by the use of the catheter. Cultures made from the urine injected into the bladder of dogs caused cystitis only in case the mucous membrane was previously injured by retention of the urine or the action of chemical irritants.

In 1887 Clado described a microbe which he found in the urine of patients suffering from cystitis, which he called "bactérie septique vessie." This microbe grew upon gelatin, which it liquefied, and rendered the nutrient medium alkaline. Pure cultures injected into the tissues of mice and rabbits produced septicæmia. Injections of the same into the bladder obstructed by ligature of the penis caused severe cystitis.

In 1889 Doyen described fourteen kinds of microbes in the urine of cystitis patients—ten kinds of bacilli and four kinds of micrococci. Injection of pure cultures of any of the bacilli into the peritoneal cavity of guinea-pigs was followed by death in from five to twenty-four hours. There is but little doubt that most of the bacilli found by French investigators in the urine of patients suffering from cystitis are identical with the colon bacillus.

In 1890 Lundström described two kinds of cystitis microbes —staphylococcus ureæ liquefaciens and staphylococcus ureæ candidus—both of which rendered the urine alkaline, besides causing the cystitis. Pure cultures injected into the bladder of rabbits, combined with temporary retention, caused cystitis of a suppurative type.

Albarran and Halle[1] were the first to make a systematic bacteriologic investigation of the urine in cystitis. Their work is based on a study of fifty cases of suppurative cystitis, pyelonephritis, and kidney abscess. In forty-seven of these cases they found numerous bacilli; in fifteen of these bacilli could be cultivated separately in pure cultures; in the rest cocci were also present. The bacillus was called "bactérie pyo-

[1] "Note sur une bactérie pyogène et rôle dans l'infection urinaire." Bulletin de l'Académie de Médecine, August 21, 1888.

gène," and Albarran came to the conclusion, as the result of his investigations, that this organism produced the greatest number of cases of cystitis.

Melchior[1] found the colon bacillus (urobacillus communis) in twenty-five out of thirty cases of cystitis, seventeen times as an isolated microbe. The bacterium next in frequency was the streptococcus pyogenes, which was found five times—three times in pure culture. In one case he cultivated from the urine the bacillus of typhoid fever, in a patient suffering from cystitis, two weeks after convalescence. From a scientific as well as from a practical stand-point it is time to admit that cystitis is invariably a microbic disease, and that the proper prophylactic precaution consists in preventing the entrance of microbes into the bladder, more especially in cases of urine retention and when the bladder is the seat of a lesion which offers a predisposition to infection. It is necessary to consider carefully and in detail the different avenues through which the bladder is reached by pathogenic microbes which are known to produce inflammation of this organ.

Infection through the Urethra. Every surgeon is familiar with the frequency with which the passage of instruments into the bladder is followed by cystitis, particularly when the urethra is the seat of inflammation, and in case catheterization is performed for retention of urine and the strictest aseptic precautions are not observed. By continuity of surface a suppurative inflammation of the urethra may extend to the bladder without instrumental intervention. Complete sterilization of catheter and hands does not always succeed in depriving catheterization of the danger of bladder infection. Pathogenic microbes are almost constantly found in the normal urethra of healthy persons.

Lusgarten and Mannaberg[2] made a bacteriologic examination of the urethra of eight healthy men, and found ten different

[1] "One Cystitis og Urininfection klinisk experimentalle og bacteriologiske Studier." 1893.

[2] "Ueber die Mikro-organismen der normalen männlichen Urethra." Vierteljahrsschrift f. Dermatologie und Syphilologie, 1887, p. 405.

kinds of microbes among them, many of which are known to produce cystitis. These observations have been fully corroborated by the researches of Roosing, Steinschneider and Galewsky, Legrain, Melchior and Petit, and Wassermann. The meatus is a favorable lodging place for microbes. If the meatus is not disinfected before the insertion of the catheter microbes may be carried with the instrument into the bladder sufficient in number and virulence to provoke a cystitis, provided they are brought in contact with a soil prepared for their reception and growth by an injury or antecedent lesion. During a recent visit to the obstetrical wards of Professor von Winckel I was informed that for some time quite a large number of the recently delivered women were suffering from cystitis. The strictest antiseptic precautions were practised in sterilizing instruments and hands, but the prevalence of this puerperal complication continued until the professor introduced an additional precautionary measure, in all cases requiring the use of the catheter—namely, disinfection of the meatus with a solution of the mercuric bichloride. From that time on cystitis from this cause disappeared. Secondary gonorrhœal cystitis following a specific urethritis, although a rare complication, does occur, but is more prone to follow a mixed infection of the urethra.

Infection by the Urine. Authors continue to insist that practically the urine is sterile, and that infection of the bladder from this source seldom if ever occurs. This statement does not agree with accurate clinical observations or the results of examination of normal urine secreted by healthy kidneys. In some cases the passage of microbes through the kidneys produces temporary lesions, which appear before the urine contains bacteria.

Schweiger[1] has shown conclusively by his careful clinical observation that the urine from scarlatinal patients is contagious; for varicella, typhus recurrens, and malaria the same holds true. In typhus Gaffky has found bacilli in the renal

[1] "Ueber das Durchgehen von Bacillen durch die Nieren." Virchow's Archiv, Band c. Heft 2.

vessels. As in most infective diseases the kidneys show textural changes, it was natural to conclude that the renal lesions were caused by microbes on their way out of the body. Schweiger looks upon all kidney lesions found in the course of infective diseases as of bacillary origin. To prove that microbes pass through the kidneys, he cultivated a bacillus which Reimann had discovered in the pus of ozæna. This bacillus is stained an intense green color in a culture of gelatin and agar after twenty-four hours. The cultures of this green bacillus were suspended in a sterilized physiological solution of salt, and injected directly into the circulation. The experiments were made on a dog, a cat, and a rabbit. The bacillus did not pass directly through the kidneys, but a certain length of time intervened between the injection and its appearance in the urine, as though somewhere an obstacle to its free passage had been met with. At first only isolated bacilli were found in the urine, but later in large numbers. In one instance he extirpated one kidney, and two days later, during the first stage of compensatory hypertrophy of the remaining organ, he injected a culture directly into the carotid artery. The animal died suddenly, two and one-half hours after the injection, in an attack of convulsions. Under strict antiseptic precautions the urine was removed from the bladder, and with it a culture of agar-agar was inoculated. The next day the culture showed a beautiful growth of the same bacillus. The author believes that the kidney, the seat of increased vascular pressure, furnished a favorable condition for the rapid passage of the microbes. He found the microbes most frequently in the glomeruli and in the space between these and Bowman's capsules, and, again, quite abundant in the bloodvessels and in the lumen of the first portion of the convoluted tubuli uriniferi, and only rarely in the perivascular spaces. Only once a bacillus was found between two epithelial cells of the convoluted tubules. In the cells themselves no bacilli were found.

Seitz found the bacillus of typhoid fever in the urine in two out of seven cases, Konjajeff in three out of twenty cases, Kneppe once in sixteen cases, and Neumann in eight out of

forty-eight cases. The last observer[1] in some instances found them so numerous that under the microscope the urine appeared like a fluid culture. In such cases the bacillus multiplies in the bladder. In two cases he also found the streptococcus pyogenes, an occurrence which he considered as an evidence of the existence of complications.

Sittmann[2] reports the results of experiments to determine the elimination of staphylococci with the urine. Rabbits were used in the experiments, and were injected in the vein of the ear with staphylococcus pyogenes aureus. After varying intervals the animals were slowly killed with chloroform and cultures made from the arterial and venous blood obtained from the right and left ventricle and from the urine. The microbes were invariably found in the urine. In the severe infection the bacteria appeared after eight hours, in lighter infection after five hours; and this condition was so constant that it was possible to predict the degree of virulence of the infection by the time of appearance of bacteria in the urine. The elimination ceased, as a rule, after forty-six hours. The author makes the statement that staphylococci can be eliminated with the urine without causing serious damage to the kidney.

Neumann[3] found the specific microbes in the urine in cases of typhoid septicæmia, and pyæmia. In a case of acute endocarditis and acute osteomyelitis, he cultivated from the urine the staphylococcus pyogenes aureus. He believes that the micro-organisms which circulate in the blood localize in the capillary vessels of the kidney, where they often cause minute multiple lesions without implication of the entire parenchyma of the organ. Through the altered tissue some of the microbes enter the tubuli uriniferi and are eliminated with the urine.

The elimination of tubercle bacilli with the urine in phthisical subjects and in animals rendered tubercular by inhalation or

[1] "Ueber Typhus Bacillen im Urin." Berliner klinische Wochenschrift, February 10, 1890.

[2] Deutsches Archiv f klinische Medicin, September 4, 1894.

[3] "Ueber die diagnostiche Bedeutung der bakteriologischen Untersuchungen bei inneren Krankheiten." Berliner klinische Wochenschrift, 1888, Nos. 7, 8, and 9.

inoculation has been proved by many reliable clinical observers and careful experimenters.

Philipowicz[1] found the bacillus of tuberculosis in the urine not only in three cases of tubercular pyelonephritis, but also in cases of acute miliary tuberculosis. If the organisms were not present in sufficient number for detection by the microscope, their presence in the urine could be proved by the injection of the urine into the peritoneal cavity of guinea-pigs. He also found bacilli in the urine in cases of glanders. In mice which had died of anthrax the urine contained bacilli in large numbers. In patients who had succumbed to ulcerative endocarditis, pus microbes were found in the urine.

Lentz[2] demonstrated the infectiousness of the urine of tubercular persons by inhalation experiments on five rabbits. The animals were confined in a box into which was introduced the steam of an atomizer mixed with the urine of two phthisical patients. For each two of the animals at one sitting thirty to forty centimetres of urine were vaporized. In two of the animals the experiment was continued daily for seventy-one consecutive days. The animals were then killed, and numerous tubercles were found in the lungs, peribronchial glands, and liver. In three of the animals the urine was allowed to decompose under a cover of filter-paper, when it was administered by the same method. One of the animals died in consequence of an abortion on the ninth day, one was killed on the forty-eighth day, the other on the sixty-ninth day. In all of the animals well-marked tubercular processes were found in the lungs and bronchial glands. The inhalation of urine from healthy persons proved harmless. From the clinical experience and the results of experimentation quoted it is evident that the elimination of pathogenic microbes through healthy kidneys may become a source of bacterial invasion of the bladder sufficient in intensity to produce an inflammation if the microbes find a

[1] "Ueber das Aufbreiten pathogene Micro-organismen im Harne." Wiener medicinische Blätter, 1885, No. 22.

[2] "Experimentelle Untersuchungen über die Infektiosität des Blutes und Urines Tuberculöser." Dissertation, Greifswald, 1881.

soil favorable for their reception and growth. This route of infection must be suspected in all cases of cystitis in which more direct infection and infection from the blood can be excluded. The existence of a suppurative affection of the kidneys or pelves, which so often precedes a similar disease of the bladder, greatly enhances the danger of infection by the urine, as the pus microbes multiply in the suppurating focus or foci and reach the bladder by way of the urine in immense number, besides the tendency of the infective process to extend from the primary lesion along the ureters to the bladder by continuity of surface.

Infection from Adjacent Organs. The bladder is often involved secondarily by the direct or indirect extension of an infective process from one of the adjacent organs. In females secondary cystitis to suppurative affections of any of the pelvic organs is of frequent occurrence. The bladder may become involved by the direct extension of an infection from its vicinity, or by infection through the lymphatics. In the latter case the inflammation is first interstitial, but may involve the mucous lining by extension of the infective process or by the rupture of an interstitial abscess into the bladder. Extension of a suppurative process in the region of the appendix or the prevesical space in the direction of the bladder is also not infrequently the direct cause of a suppurative cystitis. From an etiological standpoint cystitis caused by the migration of microbes from the intestinal canal is of the greatest importance, and has recently excited a widespread interest among bacteriologists and surgeons. The microbe which finds entrance most frequently into the bladder by this route is the bacillus coli commune. The lymphatics are undoubtedly the channels through which the invasion takes place. This microbe is found so constantly in the intestinal canal, even in healthy persons, and is, according to recent researches, so often found as the sole microbic cause of cystitis, that we are forced to admit that this mode of infection is of frequent occurrence. Clinical data as well as the results of experimentation combined to prove that the bladder is most frequently infected with this microbe from the rectum.

The migration of the colon bacillus from the intestinal canal into the bladder under certain conditions has been assumed by Fränkel, Tavel and Lanz, Arnd, Zeigler, and Blom.

Posner and Lewin[1] have furnished experimental proof of the possibility of such an occurrence. Their experiments on animals consisted in first making an intestinal obstruction by closing the anal orifice either by ligature or clamp. After one or two days the urethra was made impermeable in a similar manner. A day or two later the animal was killed and the urine examined. In a number of successful experiments a pure culture of the colon bacillus was found in the urine. These experiments prove that infection of the bladder from the rectum can take place without any gross intestinal lesions. In the same manner colored solutions injected into the rectum found their way into the bladder. Experiments with the bacillus prodigiosus and pyocyaneus yielded the same results. These observers found as the microbic causes of cystitis the bacillus coli, proteus vulgaris, staphylococcus pyogenes aureus and albus, and several times diplococci.

Wreden,[2] in his experiments on rabbits made for the purpose of demonstrating the possibility of infection of the bladder from the rectum, assured himself first that the urine was free of micro-organisms, then he injured the rectal mucous membrane by injections of very hot water, croton oil, or by irritating it by mechanical means, with the result that cystitis developed, and examination of the urine showed the existence of the same microbes as were found in the rectum. If a tampon containing the proteus or the bacillus mesentericus vulgatus was introduced into the rectum prepared in a similar manner for infection, the bacilli sooner or later appeared in the bladder.

R. Fultin[3] repeated the experiments of Wreden, and never observed bacteriæmia. In experiments in which the kidneys

[1] "Untersuchungen über die Infektion der Harnwege." Centralblatt f. die Krankheiten der Harn- und Sexual-Organe, 1896, Band vii., Heft 7 and 8.

[2] Blätter f. klinische Hydrotherapie und verwandte Heilmethoden, 1895, No. 5.

[3] "Beiträge zur Frage von den Wegen auf denen Bacterium coli commune in die Blase eindringt." Dissertation, Helsingfors, 1896.

were damaged by cantharidin the bacillus coli injected directly into veins appeared in the urine. In one series of experiments he injured the rectal mucous membrane with a sharp curette or croton oil, or both, after which carmine-stained bacteria were injected into the rectum. No cystitis resulted, and no bacteria could be found in the bladder. In another series of experiments the rectum was treated in the same manner before injecting the microbes, after which the penis was ligated for from twenty-four to twenty-eight hours. In nearly all of these cases the microbes found their way into the bladder in sufficient quantity and virulence to produce cystitis in from three to four days. In a third set of experiments only the penis was ligated. After the removal of the ligature bacteriæmia was found in about one out of five cases. If the animal was catheterized before ligation of the penis, or if the ligature was renewed after two or three days, a cystitis developed almost constantly. In the last experiments the rectum was seriously injured before the bacterial injection was made. In some of the experiments bacteria entered the bladder and produced cystitis, but peritonitis was also observed with about the same degree of frequency. In these cases bacteria were also found in the blood and kidneys. If the animals survived, the urine remained sterile, except in one instance, in which a cystitis developed slowly after a few days. In drawing conclusions from the results of his experiments, he admits that in some instances the bladder may become infected from the rectum, but he maintains that this mode of infection is comparatively rare and not as constant as claimed by Wreden. Clinical observations fully corroborate what has been established by experiments on animals—namely, that cystitis is quite frequently caused by infection from the rectum, and that this method of infection is very likely to take place when lesions of the mucous membrane of the rectum are present, which admit of a more ready entrance into the tissues and migration of the bacillus coli, and when the bladder, from retention of urine or antecedent injury or disease, is in a condition of increased susceptibility to infection.

Infection from the Blood. In rare cases infection of the bladder

takes place by microbes which float in the general circulation, with or without an antecedent or coexisting suppurating depot in some other part of the body. It has become an established fact, in connection with the origin of many of the surgical infective lesions, that the blood in the general circulation contains pathogenic microbes which produce no ill results until some tissue or part of the body becomes prepared for their localization and growth, when infection takes place in the prepared soil. Such direct connection between cause and effect has been repeatedly demonstrated experimentally between pyogenic microbes in the general circulation and the causation of suppurative osteomyelitis, synovitis, peritonitis, and tuberculosis of bones and joints. It is only rational to assume that in rare cases cystitis is produced by this method of invasion. We would naturally expect that in such cases the infection begins beneath the mucous membrane or in the middle coat, and that the lesion of the mucous membrane resulting as a secondary consequence begins as a circumscribed affection and often remains so unless retention of urine sets in and favors the dissemination of the infection over the surface of the mucous lining of the bladder. Ulcerative cystitis unquestionably has occasionally such an origin. In other cases pyogenic microbes are eliminated in sufficient number through the intact kidneys and reach the bladder with the urine, retaining a sufficient degree of virulence, when brought in contact with a favorable soil, to induce an attack of cystitis. Usually under such circumstances the cystitis is of a diffuse character. Retention of urine in such instances constitutes the most frequent predisposing cause. Infections from the blood in the causation of cystitis merit further experimental study, which will undoubtedly throw more important light upon the etiology of this disease.

In recapitulating what is known of the causes of cystitis, I am warranted in stating that a healthy bladder containing normal urine is seldom attacked by inflammation, and that when inflammation of this organ does occur, it is in consequence of the presence of one or more of the predisposing causes which have been enumerated, and the entrance into the bladder through one

of the routes mentioned of pathogenic microbes in sufficient number and virulence to produce inflammation in the tissues prepared for their pathogenic action by antecedent or coexisting injuries or disease.

II. Classification of Cystitis.

A rational classification of cystitis is essential in discussing the etiology, symptomatology, diagnosis, prognosis, and treatment of this disease. The surgeon is no longer content in simply recognizing the existence of the disease. To enable him to estimate the gravity of the affection and to adopt an intelligent course of treatment, he must be in possession of an accurate knowledge of its real nature, location, and extent. He must know what microbe or microbes have produced the inflammation before he can make a diagnosis that will suggest the necessary therapeutic indications. Mistaken and inaccurate diagnoses are largely responsible for the many shortcomings of our present therapeutic resources. For the purpose of showing some of the defects of the methods of classification of cystitis heretofore made by authors who have made a special study of this disease, I will give only the classifications of Guyon and Roosing.

Guyon's Classification of Cystitis. 1. Cystitis blenorrhagique. 2. Cystitis tuberculeuse. 3. Cystitis calculeuse. 4. Cystitis des rétrecis. 5. Cystitis des prostatiques. 6. Cystitis des néoplasiques. 7. Cystitis chez la femme. 8. Cystitis doloreuse. 9 Cystitis membraneuse.

I can see no reason for discussing cystitis as it occurs in women as a separate affection; neither is it necessary in classifying cystitis to consider separately the different causes which give rise to irritation of the bladder or retention of urine. Cystitis is always a painful affection, and there is absolutely no excuse for setting aside a class of cases in which this symptom may be more prominent than in others as a separate variety under the head of cystitis doloreuse.

Roosing's Classification of Cystitis. 1. Cystitis catarrhalis. 2. Cystitis suppurativa. The latter class he subdivides

again into (*a*) cystitis suppurativa ammoniacalis and (*b*) cystitis suppurativa acida s. tuberculosa.

Roosing's classification has special reference to the action of the essential microbic cause on the urine and the tissues of the bladder, but it is well known that in many cases of non-tubercular cystitis the urine is acid, especially in cases in which the colon bacillus is found as the sole microbic cause. This classification ignores also almost completely the different pathological varieties with which the surgeon must be familiar in order to comprehend the nature and extent of the disease. No classification is complete which does not indicate the anatomical location, the clinical features, pathological characteristics, and bacteriological origin of the disease.

1. Anatomical Classification. (*a*) Pericystitis; (*b*) paracystitis; (*c*) interstitial cystitis; (*d*) endocystitis.

(*a*) *Pericystitis.* Cystitis is the term usually employed in designating an inflammation of the bladder without any special reference to what tissues are the seat of the inflammatory process. In the diagnosis of all diseases it is of the greatest importance to determine, if possible, the organ or tissues in which the disease had its starting-point; in other words, to make first an anatomical diagnosis. Although the mucous membrane of the bladder is most frequently primarily affected in cystitis, either of the remaining two tunics may be the primary starting-point of the inflammatory process from which the infection may or may not extend to the mucous membrane, but the symptoms usually point in that direction.

Guyon[1] calls attention to the great difficulties which the surgeon frequently encounters in the differential diagnosis between cystitis and neoplasms of the bladder. He demonstrated in his clinic two patients in which, besides the usual symptoms of cystitis, an infiltration of the bladder wall simulated tumor. Suprapubic incision of the bladder cleared up the diagnosis, as it revealed a well-marked pericystitic infiltration. In a third case the symptoms which had existed for eight months appeared

[1] "Diagnostic différentiel de certaines formes de la cystite et des néoplasmes de vessie." Annales des Maladies des Organes génito-urinaires, 1895, No. 4.

to point directly to cystitis, when a perineal section made it clear that it was a case of carcinoma.

In pericystitis the peritoneal coat of the bladder is the seat of inflammation; it is in reality a vesical peritonitis. The anatomical form of cystitis follows usually in consequence of the extension of an inflammation from one of the adjacent organs—the appendix, uterus, tubes, or ovaries; in rare instances it is caused by intestinal perforation. The inflammatory product is most abundant around the base and at the sides of the bladder. At the sides of the bladder, at a point corresponding with the vesical end of the ureter, the inflammatory masses often reach considerable size, and by cicatricial contraction may eventually cause ureteral obstruction. In the female, vesical peritonitis is usually secondary to pelvic peritonitis. The immobilization of the bladder by adhesions and the vascular disturbances caused by the pericystitis are often productive of great vesical distress, and in secondary pathological changes often reach the mucous membrane of the bladder.

Dacheux[1] believes that the condition of irritable bladder in women, which has previously been regarded as a purely functional disorder, is really, as Zuckerkandl states, due to localized hyperæmia of the mucous membrane, which can be demonstrated by cystoscopic examination. Hyperæmic patches are seen at the base of the bladder, and less often at the neck, which bear a close etiological relation to concomitant congestion of the uterus and adnexa, and often disappear when the latter is relieved.

Kolischer[2] describes, in connection with such cases, a peculiar form of œdema of the mucous membrane of the bladder observed through the cystoscope. It appears in the form of circumscribed blisters the size of a pea, the rest of the membrane being normal. In some cases the blebs are so large as to resemble vesicular moles. This pathological condition is always associated with pelvic exudates near the bladder, and is seen most frequently in women the subjects of salpingitis. The

[1] Centralblatt f. Gynäkologie, 1895, No. 40.
[2] Ibid., No. 27.

symptoms which attend this form of vesical irritation are painful urination, tenesmus, and a feeling of weight and pressure over the bladder. While the clinical symptoms indicate the presence of cystitis, examination of the urine yields negative results, unless the infection has extended to the mucous membrane of the bladder.

(*b*) *Paracystitis.* Paracystitis is an inflammation of the subperitoneal connective tissue of the bladder or of the surrounding connective tissue where the bladder is extraperitoneal in the cavum Retzii and prostatic portion of the organ. At the base of the bladder a paracystitis not unfrequently develops in the course of a suppurative prostatitis, and in front of the bladder the disease usually appears in the form of a phlegmonous inflammation of the loose connective tissue in the cavity of Retzius. In both of these locations abscess formation is the usual termination of the inflammatory process, an occurrence always attended by distressing bladder symptoms. Abscesses in both of these places, unless incised early, are very prone to rupture into the bladder, an accident which is often followed by an obstinate cystitis. Inflammation of the subserous connective tissue, following infection through the lymphatic channels, is a very obscure affection, and a positive diagnosis is more frequently made in the post-mortem room than at the bedside. The formation of multiple abscesses in such cases is not an unusual occurrence. More or less paracystitis is almost always associated with pericystitis involving the intraperitoneal portion of the bladder.

(*c*) *Interstitial Cystitis.* Interstitial cystitis implicates the middle tunic or muscular coat of the bladder. It is in this coat that we find the lymph channels most numerous, and consequently the most common pathways of infection. Invasion of the middle coat may take place from either direction, either by extension of infection from the mucous lining, or the microbes reach the muscular coat through the lymph-channels from some adjacent inflammatory focus. Another, but perhaps the rarest, route of infection is through the circulation, when the interstitial cystitis is initiated by an endo- or perivascular

inflammation. Direct extension of inflammation of the mucous membrane to the muscular coat, or invasion by way of the lymphatic channels, usually leads to a diffuse inflammation in which the whole middle coat may participate, in which case it becomes greatly thickened and the mucous membrane is changed into folds. Ridges can be felt with the sound. Interstitial cystitis usually leads to abscess formation. Small abscesses develop in the submucous connective tissue, or in the muscular coat, which, when they open into the bladder, leave diverticula which heal slowly and in which calculi are often found concealed. Recovery from this form of cystitis often results in a great diminution in the size of the bladder, caused by cicatricial contraction. In the embolic form of interstitial cystitis circumscribed inflammation and abscess formation are the usual results of the infection.

(*d*) *Endocystitis.* What is ordinarily understood by cystitis is an inflammation of the lining membrane of the bladder. The inflammation may almost from the beginning, at any rate in a few days, involve the entire surface of the mucous membrane, or it may remain limited to certain localities which are most exposed to infection. Localized cystitis is found most frequently in the trigonum and about the urethral and ureteral orifices; it is also from these points that diffuse cystitis has its starting-point. The neck of the bladder is the most sensitive part of the organ, and it is here that inflammation gives rise to the most distressing symptoms. In cystitis proper the urine contains, almost from the very beginning, the morphological elements of the inflammatory product—blood, epithelial cells, and pus-corpuscles—the presence of which always constitutes an important distinguishing feature between endocystitis and the other anatomical varieties of inflammation of the bladder. In the further discussion of the classification of cystitis, endocystitis, or cystitis proper, will be taken as the type of the disease.

2. Pathological Classification. (*a*) Catarrhal cystitis; (*b*) suppurative cystitis; (*c*) ulcerative cystitis; (*d*) exudative cystitis; (*e*) exfoliative cystitis.

The effects of microbes and their toxins on the tissues of the bladder vary according to the specific pathogenic effect of the original bacterial cause and the number of microbes and their degree of virulence. The inflammatory product is also greatly influenced by the condition of the urine and the nature and extent of the predisposing causes. The successful treatment of cystitis is often materially influenced by the character of the inflammation and the nature of complications which may precede, attend, or follow cystitis. I am sure every surgeon will appreciate the value and importance of a clear pathological classification of cystitis for the purpose of grouping his cases properly from a pathological stand-point and as a reliable aid to diagnosis and treatment. The pathological classification must be based entirely on the character of the inflammatory product.

(*a*) *Catarrhal Cystitis.* For a long time catarrh of the bladder has been regarded as synonymous with chronic inflammation. German writers have been particularly partial to this term, which has made so much confusion in the literature on inflammatory affections of the bladder. From a modern pathological stand-point catarrhal cystitis is a term used to indicate the existence of a superficial inflammation of the interior of the bladder in which the epithelial cells furnish the principal part of the morphological elements of the inflammatory product. It is, like all other catarrhal inflammations in other localities, a surface affection. The mucous membrane is swollen, red, and the inflammatory process consists in increased exfoliation of epithelial cells and an abundance of mucus formation. If the disease becomes chronic, thickening of the mucous membrane and secondary infiltration of the muscular coat lead to hypertrophy of the bladder wall. Retention of the urine aggravates the inflammation and increases the vesical distress. Erosions and superficial ulcerations may develop during the course of the disease. The urine is usually acid, and contains pus and an abundance of bladder epithelium. In cases in which the urine has undergone alkaline decomposition the inflamed surface presents a dirty-whitish deposit of muco-pus.

Roosing[1] is of the opinion that in catarrhal cystitis the microbes which produce the disease do not attack the mucous membrane of the bladder, but that they provoke the disease by rendering the urine ammoniacal, while in suppurative cystitis, besides doing this, their pyogenic action is expended upon the mucous membrane prepared for their specific action on the tissues by the preceding catarrhal inflammation. It is not always easy, nor sometimes possible, to draw a sharp line between catarrhal cystitis and suppurative cystitis, because the latter frequently follows upon the footsteps of the former, and the transition is often so gradual that it is impossible to tell where one ends and the other begins. From a clinical standpoint the differentiation between these closely allied inflammatory affections of the bladder is perhaps attended by less difficulty, as suppurative cystitis gives rise to more serious constitutional disturbances than catarrhal cystitis, owing to the existence of a more intense infection and more extensive involvement and destruction of tissue.

(*b*) *Suppurative Cystitis.* Suppurative cystitis appears clinically usually as a diffuse affection, in which not only the epithelial lining but also the deeper structures are generally involved. The microbic infection is of sufficient intensity to destroy the protoplasm of the morphological products of the inflammation, white corpuscles and purely epithelial and connective-tissue cells, and transform them into pus-corpuscles. The urine contains large quantities of pus and bladder epithelia. During the acute stage small fibrinous patches appear upon the inflamed surface. Ulceration differing in extent and depth is of common occurrence. Deep necrosis may lead to perforation. If the urine is ammoniacal, the necrosed patches present a grayish-white color and are encrusted with sand-like deposits. The decomposition of the urine is generally due to other microbes than those which have caused the suppurative inflammation; that is, it is generally the result of a mixed infection. Besides the usual pyogenic microbes, the ammoniacal urine contains some species of sapro-

[1] "One Blaerebetaendelsernes Aetiologi, Pathogenese og Behundling," Kjoebenhavn, 1889.

phytic bacteria or the diplococcus ureæ. Suppurative cystitis generally begins as an acute inflammation, but is very liable to pass into the chronic form, and direct extension of the infective process is liable to implicate, sooner or later, the kidneys.

(*c*) *Ulcerative Cystitis.* In this class of cystitis it is not my intention to include the cases of suppurative cystitis which terminate in ulceration, which would only indicate an advanced stage of the disease, but I desire to limit the application of the qualifying term ulcerative to a form of cystitis in which ulceration takes place almost from the beginning of the inflammation. In cases of this kind the infection appears to be of a peculiar kind, limited in extent, and the resulting inflammation leads quickly to a circumscribed destruction of tissue, the formation usually of a single circumscribed ulcer, the so-called "simple" ulcer of the bladder. This form of cystitis is quite rare, and resembles in many respects gastric ulcer and the round duodenal ulcer.

Fenwick[1] has seen a number of cases of simple, solitary ulcer of the bladder. The disease is usually met with in young men without a venereal history. The first symptom is increased desire to urinate, coming on suddenly; intermittent hæmaturia then appears. He describes three stages. In the first stage the urine is acid, the specific gravity high, and pus scanty. In the second stage, the ulcer becomes encrusted with phosphates, and fragments of the deposit break off now and then and are passed with the painful paroxysms, or are retained and serve as nuclei for calculus formation. During the third stage the bladder becomes contracted, the mucous membrane extensively ulcerated, and ureteral and renal lesions arise. Solitary ulcer is clinically indicated if the urine is clear and normal in specific gravity and reaction, and there is constant penile pain and absence of nocturnal irritability. This form of cystitis is undoubtedly the result of an infection from the blood, the inflammation attacking the tissues around an infected embolic infarct, reaching the surface of the bladder by a process of ulceration.

[1] British Medical Journal, May 9, 1896.

Like gastric and duodenal ulcer, ulcerative cystitis is found in preference in young adults, and usually without any antecedent or attending predisposing local causes.

(*d*) *Exudative Cystitis.* Inflammation of the mucous membrane of the bladder accompanied by the deposition upon the inflamed surface of the products of coagulation necrosis should be called exudative cystitis. The descriptive terms membranous, diphtheritic, croupous, and fibrinous are confusing and misleading, and should be excluded from the present nomenclature in the description of this pathological form of cystitis. The exudate consists largely of fibrin, and is variously modified in quantity and appearance by the character of the infection and the condition of the urine. The exudate is the best possible proof of the severity of the infection and intensity of the inflammation. It proves the existence of a deep-seated lesion and great damage to the bloodvessels in the inflamed tissues. This form of cystitis is most frequently observed in puerperal women and women suffering from pelvic tumors large enough to subject the bladder to harmful pressure.

According to Stein, of fifty cases of exudative cystitis, forty-five occurred in women, mostly in connection with the puerperal state or tumors of the uterus. In the milder types of this disease the mucous membrane under the fibrinous exudate is vascular and swollen; in the grave cases the mucous membrane and submucous connective tissue are often extensively destroyed by acute necrosis or ulceration.

Adami[1] studied a case of this kind in a woman the subject of a myofibroma of the uterus large enough to produce considerable pelvic pressure. To pressure and obstruction of the lymph-stream he attributed important elements in the etiology of this variety of cystitis. The membranes and shreds were passed after great pain and distress. The membranes were found to be composed of a large amount of fibrin, and incorporated in this what were evidently layers of the bladder wall. In many of the cases not only epithelial layers but also a certain amount

[1] Montreal Medical Journal, July, 1894.

of the muscle tissue of the bladder wall have thus become destroyed.

Savor[1] observed a case of exudative cystitis on the fourth day after extirpation of the uterus by the abdominal route. Catheter was not used either before or after operation. Membranes five to ten centimetres in length were expelled with the urine. These membranes were composed of fibrin and contained in the meshes of the fibrin numerous pus-corpuscles. The urine was ammoniacal only for one day. In the urine sediment the colon bacillus was found, and was regarded by the author as the essential microbic cause of the inflammation. Savor made experiments with pure cultures of this bacillus with a view of reproducing this special form of inflammation upon serous and mucous surfaces of other organs in animals, but the results of his endeavors proved negative. The urine in exudative cystitis is usually alkaline, and Savor believed that in his case it remained acid after the first day, owing to the absence of a mixed infection. In the majority of cases exudative cystitis occurs in women during the child-bearing period, and positive proof of the pathological nature of the cystitis is always furnished by the expulsion with the urine of membranes or shreds of fibrin.

(*e*) *Exfoliative Cystitis.* Exfoliative cystitis is an inflammation of the bladder in which, almost from the very beginning, the toxins of the microbes which produce the disease destroy the mucous membrane and sometimes even the muscular coat, which, if the patient survive, become detached by the inflammatory product and are expelled with the urine, or in some instances have to be extracted from the bladder by the surgeon. This is the most dangerous form of cystitis, and can occur only as the result of a most virulent infection, aided in most cases by local predisposing causes. In exudative cystitis the toxin precipitates the inflammatory product by causing coagulation necrosis; in exfoliative cystitis it causes necrosis of the mucous lining of the bladder and occasionally also of the muscular coat.

[1] "Cystitis crouposa bei saurem Harn," Wiener klinische Wochenschrift, 1895, No. 44.

The same mechanical causes which are so influential in causing exudative cystitis are usually present and active in the production of exfoliative cystitis. In a few cases carcinoma of the bladder appears to have been the predisposing cause of this form of cystitis, with the result that the disease was completely removed by the extensive sloughing, and in a few instances the patients not only recovered from the cystitis, but were permanently cured of the carcinoma by the complete elimination of the malignant tissue with the product of the exfoliative process.

A very interesting case of extensive exfoliative cystitis is reported by J. C. Warren.[1] Under an anæsthetic "rolls of sloughing tissue" were extracted with forceps until a "membrane the size of a small pocket-handkerchief" had been removed from the bladder in a connected mass. The patient suffered first from incontinence, but gradually recovered under daily washings out of the bladder with a weak solution of potassium permanganate, and later with a solution of boric acid. An examination of the specimen removed showed it to be of a character similar to the submucosa of the bladder.

Boldt,[2] under the term suppurative exfoliative cystitis, describes this form of cystitis, marked by inflammatory separation *en masse* of portions of the mucous lining of the bladder, due especially, as he believes, to posterior displacements of the gravid uterus, to undue or prolonged pressure of the fœtal head in labor, or other mechanical causes. The degree and extent of the exfoliation vary with the intensity of the mechanical cause and the virulence of the infection. The differentiation between exudative and exfoliative cystitis can be made only by a careful study of the membranes, shreds, or masses expelled or removed from the bladder, which often must necessarily include the use of the microscope as a diagnostic aid.

3. Clinical Classification. (*a*) Acute cystitis; (*b*) chronic cystitis.

(*a*) *Acute Cystitis.* The old and usual clinical diagnosis is based on the intensity of symptoms and duration of the disease.

[1] Boston Medical and Surgical Journal, June 25, 1896.

[2] American Journal of Obstetrics, April 27, 1889.

Acute cystitis is known as that form of inflammation of the bladder in which the symptoms appear suddenly and reach their maximum height in a short time. In this class of cases the infection is intense, the constitutional disturbances well marked, and the nature of the pathological products in accordance with the acuity of the inflammatory process. One of the best illustrations of what is meant by acute cystitis is furnished by cases of urine retention in which infection occurs by the use of the catheter. The disease is usually initiated by a chill followed by febrile reaction; the urine becomes turbid within twenty-four hours, and in a few days contains large quantities of pus, and ammoniacal decomposition is developed very rapidly. It is not difficult in the majority of cases to establish the existence of acute cystitis, but such a diagnosis no longer satisfies the surgeon who seeks to complete his diagnostic work by investigating the pathological anatomy of the disease and by ascertaining the nature of the infection. Under appropriate treatment an acute cystitis may be under control in a short time, but in the presence of obstructive or visceral lesions the acute symptoms subside in the course of time, when the disease only too often passes into the chronic form.

(*b*) *Chronic Cystitis.* Chronic inflammation of the bladder is characterized by the absence of acute symptoms, local and general, and the tendency of the disease to persist regardless of the treatment employed. The suppurative form of chronic cystitis is usually complicated by the coexistence of stricture of the urethra, enlarged prostate, or the presence of stone or foreign body in the bladder. Cystitis caused by infection from a suppurative affection of the kidneys is also very prone to pursue a chronic course, as the constant irrigation of the bladder with infected pus maintains an uninterrupted source of infection. The best example illustrating the clinical aspects of chronic cystitis is furnished by tubercular cystitis. The disease begins insidiously by the appearance of isolated symptoms which point to the bladder as the probable seat of the inflammation. The symptoms gradually increase in number and intensity until the complexus is complete upon which to base a diagnosis of

chronic cystitis. The symptoms are often masked by complications which served as predisposing causes or which ensued in consequence of the chronic inflammation. It is in cases of chronic cystitis that an early and correct diagnosis is so seldom made. Renal disease is often mistaken for cystitis, and cystitis for renal disease. It is in such cases that a recourse to all modern diagnostic aids is indispensable for a correct interpretation of the symptoms as they arise. It is not unusual that patients suffering from incipient tuberculosis of the bladder go from one physician to another, and are repeatedly sounded for stone in the bladder, when perhaps the results obtained from a careful examination of the external genitals and the prostate would at once arouse suspicions in reference to the probable tubercular nature of the vesical affection. It is well to remember that in the majority of cases of chronic inflammation of the bladder not complicated by obstructive lesions the disease is of a tubercular nature.

4. Bacteriological Classification. (*a*) Bacillus coli commune infection; (*b*) saprophytic (mixed) infection; (*c*) staphylococcus infection; (*d*) streptococcus infection; (*e*) streptococcus erysipelatis infection; (*f*) typhoid bacillus infection; (*g*) diplobacillus infection; (*h*) gonococcus infection; (*i*) bacillus of tuberculosis infection.

The bacteriological classification of cystitis is the most modern and certainly the most important. The bacteriological classification has a direct bearing on the etiology of the disease, and suggests to the surgeon the most rational course to pursue in its treatment. In long-standing and obscure cases of inflammation of the bladder examination is not complete without an examination of the urine with sufficient care and thoroughness upon which to base a correct bacteriological classification. Surgeons must learn to appreciate the value and importance of this part of the examination before we can expect material advances in the treatment of cystitis. If the surgeon has not the necessary knowledge or equipment to make these examinations satisfactorily, he should assign this part of his task to a competent bacteriologist.

(*a*) *Bacillus Coli Commune.* Bacteriological researches made by numerous observers go to prove that the bacillus coli commune is found more frequently in the urine of patients suffering from cystitis than any other known microbe, and all combine in assigning to it a more or less important *rôle* in the causation of the disease. This micro-organism was discovered by Escherich[1] in 1886. It is constantly found in the contents of the normal intestinal canal. Its presence in suppurative affections in different parts of the body has been repeatedly demonstrated, and its pathogenic qualities have been carefully determined. Since 1891 the colon bacillus has been demonstrated in the urine in cystitis patients by Achard and Renault, Reblaub, Henshalter, Hartmann, Guinon, and Denys, all of whom claimed for it distinct etiologic qualities.

Roosing[2] has reported a number of cases of infection of the upper portion of the urinary tract in which myriads of the colon bacilli were found in the urine without having produced cystitis. If in such cases another microbe finds its way into the bladder which will decompose the urine, cystitis invariably follows. The colon bacillus does not decompose urea. The ordinary pus microbes decompose the urine, and are almost constantly found in cases of cystitis in which the colon bacillus is found in abundance. The microbes which are known to decompose urea are bacterium pyocyaneus, coccobacillus pyogenes ureæ, staphylococcus, and a special form of streptococcus found in decomposed urine.

Roosing ascertained, also, that in dead culture media the colon bacillus exerts a destructive, or at least an inhibiting effect on the bacteria which decompose urine. The correctness of these observations is sustained by the investigations of Beco, Wothelet, Charin and Veillon, Tavel and Lanz, Albarran, Halle, Melchior, Guyon, Schmidt, Krogius, and Schoff, all assigning to the bacillus coli distinct and important pathogenic properties in the genesis of cystitis. Recent observations tend

[1] "Die Darmbacterien des Säuglings." Stuttgart, 1886.

[2] "Die Bedeutung des Bacterium coli f. die Pathologie des Harnorgane." Hospitals Tidende, 1895, No. 32.

to prove that the colon bacillus requires the co-operation of urine-decomposing bacteria in the production of cystitis.

Trumpp[1] made a bacteriological examination of the urine in twenty-nine cases of cystitis in children (eight boys, twenty-one girls), in the clinic of Escherich. Of these cases seventeen were suffering at the same time from follicular enteritis. In fourteen the bacillus coli was found. The cystitis in these cases was characterized by grave general symptoms, slow progression of the infective process in the direction of the kidneys, and occasionally a fatal nephritis.

Melchior found the urine acid in all cases of cystitis in which the colon bacillus was found as a solitary microbe. His experiments on rabbits, guinea-pigs, and mice with pure cultures injected into the veins, beneath the skin, and into serous cavities proved the pyogenic properties of this microbe. He is of the opinion that many of the bacilli discovered in the urine of cystitis patients and described under different names are identical with the colon bacillus. Of thirty-seven cases of cystitis examined by Melchior, the colon bacillus was found in thirteen (twelve times solitary); diplococcus ureæ liquefaciens, eleven times (nine times solitary); proteus Hauser, five times (three times solitary); and staphylococcus pyogenes, four times (three times solitary). It seems that the colon bacillus under certain favorable circumstances can and does produce cystitis, but it is equally certain that its pathogenic properties are greatly enhanced when it is associated with bacteria which decompose the urine. It is found most frequently in the urine in cases of cystitis caused by a mixed infection. Colon-bacillus infection should be suspected in all cases of cystitis following operations upon the rectum, and when the disease has followed or is coexistent with intestinal fermentation, irritation, or inflammation; also in cases in which the urine remains acid.

(*b*) *Saprophytic* (*Mixed*) *Infection.* In more than one-half of all cases of cystitis acute and chronic infection is the result of the presence and combined action of several different kinds of

[1] "Ueber Colicystitis in Kindesalter." Münchener medicinische Wochenschrift, 1896, No. 42.

microbes. Pus microbes and the saprophytes decompose the urine, rendering it alkaline. Ammoniacal urine acts as an irritant to the mucous membrane of the bladder, producing textural changes which prepare the way for the action of the bacteria which are more directly concerned in the production of the inflammation. A mixed infection must be suspected in all cases in which the urine is ammoniacal.

Mesnil de Rochemont[1] cultivated from the urine of twenty-five cases of cystitis fourteen different kinds of microbes, one-half of which decomposed urea; the remaining half had no such effect.

Kastalskaya,[2] from a bacteriological study of urine from the bladder in twelve cases of cystitis, reports the following results: In one case he found the bacillus fœtidus liquefaciens mixed with tubercle bacilli and non-pathogenic cocci; in five cases tubercle bacilli, twice as a pure culture, once mixed with non-pathogenic cocci and bacillus coli, and once with non-pathogenic cocci and the bacillus fœtidus liquefaciens; in four cases the bacillus coli, twice as a pure culture, once with non-pathogenic cocci and tubercle bacilli, and once with streptococcus pyogenes; in one case pseudobacillus coli commune as a pure culture; in one case bacilli with non-pathogenic cocci; in one case streptococcus pyogenes with bacillus coli; and in one case a pure culture of pseudostaphylococcus albus.

Lépine and Roux,[3] of Lyons, proved by numerous experiments with dogs and guinea-pigs that the introduction into the urethra of a pure culture of the micrococcus ureæ, followed by temporary ligation of the urethra, invariably resulted in ammoniacal fermentation of the urine and cystitis with grave lesions. Decomposition of the urine occasionally is attended by gas formation (pneumaturia), and in such instances some form of gasogenic bacteria can be found. Heyse[4] records a case of gas formation in the bladder of a patient suffering from myelitis

[1] Op. cit. [2] Zeitschrift f. Geburtshülfe und Gynäkologie, Band xxxv. Heft 1.

[3] Comptes rendus hebdomadaires des séances de l'Académie des sciences. Paris, July, 1894.

[4] Zeitschrift f. klinische Medicin, Band xxiv.

with retention of urine. After catheterization had been practised for some time gas was noticed escaping through the catheter. Autopsy showed gas in considerable quantities in the bladder, ureter, and substance of the kidneys. Cultures revealed the presence of a short bacillus resembling the bacterium lactis aerogenes of Escherich. Pure cultures injected into the tissues of animals always resulted in gas formation.

Schnitzler[1] reports an analogous case in a woman forty-six years old, the only difference being that the catheter had never been used. Here, also, the formation of gas was due to the presence of the bacillus lactis aerogenes. The author made experiments with the bacillus coli for the purpose of showing its gas-producing effect, but succeeded only in animals he had first rendered diabetic by phloridzin. In the same way the injection of the bacillus lactis aerogenes produced violent cystitis, but developed gas only in animals rendered diabetic. These experiments show that decomposition of urea and putrefaction caused by microbes is often greatly influenced by the composition of the urine. Saprophytic infection is almost always associated with urine retention, and may precede or follow infection with the microbes which are the essential cause of the suppurative cystitis. It is in such cases that careful, systematic catheterization and antiseptic irrigations of the bladder prove of such eminent value in correcting the alkalinity of the urine and in arresting the suppurative inflammation.

(*c*) *Staphylococcus Infection.* The staphylococcus pyogenes albus and aureus, the microbe most frequently found in all suppurative affections, has been often demonstrated as a solitary microbe, and in association with other pyogenic microbes and saprophytic bacteria in the urine of patients suffering from catarrhal and suppurative cystitis. The staphylococcus is a comparatively mild microbe, and its presence as a sole microbic cause should be suspected in inflammatory affections of the bladder in which the infection does not penetrate deeply, and in which the urine shows no evidences of exfoliation. In staphy-

[1] Internationale klinische Rundschau, February 25, 1894.

lococcus infection the urine may be ammoniacal without the presence of saprophytic bacteria, as pus microbes, when present in large numbers, decompose the urea, besides lighting up the suppurative inflammation.

(*d*) *Streptococcus Infection.* That the streptococcus pyogenes is not often the cause of cystitis becomes apparent from a bacteriological examination of the urine from six cases of inflammation of the bladder made by Huber.[1] He found this microbe only once; in the remaining five cases the bacillus coli commune.

Melchior found the urine acid in all cases of cystitis in which the streptococcus was found as a solitary microbe. It is well known that the streptococcus generally produces a diffuse form of inflammation, during which the connective tissue is often destroyed by the toxins, and is later eliminated or removed in the form of shreds. The streptococcus invades the lymphatic channels and connective-tissue spaces, and is almost constantly found in all phlegmonous inflammations and diffuse abscesses. A streptococcus cystitis is characterized by the intensity of the local and general symptoms and more or less obstruction of the tissues of the bladder wall. The presence of this microbe may be presumed in cases of diffuse interstitial and exfoliative cystitis.

(*e*) *Erysipelatous Cystitis.* Erysipelatous inflammation, either as a primary affection or as a metastatic process, has been found in many of the internal organs. Infection of the bladder with the streptococcus erysipelatis is extremely rare, but there can be no doubt of the possibility of such an occurrence.

Fritsch[2] reports the case of a man, aged fifty-two years, suffering for a long time from symptoms of suppurative prostatitis, and who was attacked with chills, fever, vomiting, and frequent desire to urinate; the urine, very turbid, contained streptococci, as did also the mucopurulent secretions of the prostate. The erysipelatous character of the cystitis was demonstrated by culture and inoculation experiments. The patient suffered subsequently from an erysipelas of the left

[1] Correspondenzblatt f. Schweizer Aerzte, October, 1893.

[2] Centralblatt f. Chirurgie, 1894, No. 7.

thigh, which extended to the right thigh, the back, etc., but eventually he recovered.

(*f*) *Typhoid Infection.* Our distinguished member, Professor W. W. Keen, has recently made a most important addition to the literature pertaining to typhoid infection and complications, in his classical book on *The Surgery of Typhoid Fever.* He mentions a number of cases of typhoid infection of the male and female genital organs, but nothing is said of cystitis as a possible complication or remote consequence of typhoid fever.

Melchior[1] reported the first and probably the only case of cystitis caused by infection with the typhoid bacillus. The patient had been convalescent from an attack of typical typhoid fever for fourteen days, and had been out of bed for three days, when he was attacked suddenly with a severe form of cystitis, for which there appeared to be no cause, as the catheter had never been used. For several days the urine was sterile, and contained a large amount of pus and some blood. The typhoid bacillus was cultivated from the urine, and was the only microbe it contained. In rabbits injections of pure cultures into the bladder obstructed for eighteen hours by ligation of the penis caused a severe cystitis. Intravenous injections caused death of the animals from typhoid fever with the characteristic anatomical lesions.

(*g*) *Diplobacillus Infection.* The diplobacillus of Friedländer, which has been found in so many suppurative lesions complicating or following pneumonia, has in rare instances been found as the only microbic cause of cystitis. In a case of general infection with this microbe which resulted in death, Brunner[2] found at the post-mortem, besides other multiple lesions, hemorrhagic lesions.

Montt-Saverdo[3] found the diplobacillus of Friedländer in the urine of two cases of cystitis, which, in the absence of other microbes, was regarded by him as the essential cause of the

[1] " One Cystitis og Urininfection," etc.

[2] Münchener medicinische Wochenschrift, 1896, Nos. 13, 14.

[3] " Zwei Fälle von Cystitis mit Befund von Diplobacillus Friedländer." Centralblatt f. Bakteriologie, etc., 1896, Band xx. Nos. 4, 5.

disease. The first patient was a man, aged fifty-three years, who three years previously suffered from an attack of pneumonia. For two months he had been the subject of cystitis characterized by the escape of gas from the urethra. The urine contained pus, a small quantity of albumen, diplobacilli, and no gonococci. In the second case the suppurative cystitis was complicated by hypertrophy of the prostate. The symptoms yielded to washings out of the bladder with solutions of salol and nitrate of silver. Five years later, return of the cystitis, phlebitis of the saphenous vein, death, preceded by septic manifestations. The autopsy revealed carcinoma of the prostate and conditions indicated by the clinical course of the disease, also a few broncho-pneumonic foci. Bacteriological examination of the urine resulted in the finding of staphylococcus pyogenes and the diplobacillus of Friedländer.

(*h*) *Gonococcus Infection.* It has been said that the gonococcus never causes cystitis, and that a gonorrhœal urethritis, as long as it remains as an unmixed infection, does not extend to the bladder. It is claimed that when cystitis develops in the course of a specific urethritis it is the result of a mixed infection. This is undoubtedly true in the majority of cases, but occasionally a gonorrhœal cystitis is met with in which the gonococcus is found as a solitary microbe in the urine. It is not always easy to demonstrate the gonococcus in the urine in gonorrhœal cystitis. The reason why gonococci are not always found in the chronic cases, as Wertheim has pointed out, is that, while young gonococci are well stained with aqueous solutions of anilin colors, the old germs are pale and imperfectly defined. Moreover, gonococci assume "involution forms," becoming granular and of irregular form when the culture medium becomes old. These forms are not recognizable as gonococci, yet they can be regenerated to the classical form through a fresh culture medium. Gonorrhœal cystitis presents itself more frequently in the form of a localized than a diffuse inflammation of the bladder. The favorite location for this form of cystitis is the trigonum of the bladder. If the disease becomes more diffuse, it manifests a tendency to extend in the direction

of the kidneys. The most conclusive proof of the existence of gonorrhœal cystitis has been furnished by Wertheim.[1] In a girl aged nine years, suffering from gonorrhœal cystitis, he excised with the aid of the cystoscope a piece of the mucous membrane of the bladder, in which he found an abundance of gonococci in the tissues of the specimen removed; some of the gonococci were seen between the epithelial cells; some had penetrated deeper into the vessels, where they had produced gonorrhœal thrombosis in the capillaries and veins.

(*i*) *Tubercular Cystitis.* Tubercular cystitis furnishes the best clinical representation of chronic cystitis. With few exceptions, a primary chronic cystitis is of a tubercular nature. It is important to bear this in mind in the examination of all cases of cystitis in which the initial symptoms point to a chronic inflammatory process.

Tuberculosis of the bladder is caused either by infection with the bacillus of tuberculosis through the blood, by extension of a tubercular process, by continuity of surface from the kidney or the genital organs, or by the rupture of a tubercular abscess into the bladder. Vesical tuberculosis is found more frequently in males than in females, and is usually a disease of early and middle life. Tuberculosis of the bladder in the male is generally associated with a similar affection of the seminal vesicles and prostate. Localization of tubercle bacilli in the mucous membrane of the bladder, like that of pyogenic and saprophytic bacteria, is favored by antecedent affections of the urinary tract. Primary tuberculosis from infection through the blood is so rare that König doubts its existence. Infection takes place most frequently from the kidneys; less frequently from the prostate, seminal vesicles, and epididymis. The resistance of the mucous membrane of the bladder to tubercle bacilli is great. In many cases tuberculosis of the kidneys may exist for several years without affecting the bladder. The mucous membrane of the bladder can be irrigated with urine containing tubercle bacilli for years without becoming tubercular. Clado pointed

[1] "Ueber Blasengonorrhöe." Zeitschrift f. Geburtshülfe, Band xxxv. Heft 1.

out that tubercular granulations in the bladder do not, as is claimed by some authors, occupy the submucous tissue, but the mucous membrane itself—that is, the subepithelial layer. He believes that this is due to the presence of a well-developed capillary network in the mucous membrane, which determines localization of the bacilli floating in the general circulation. Secondary infection occurs most frequently from the prostate or the kidneys, and least frequently as a result of an ascending tuberculous affection of the testicles. In other cases the bladder is involved by the rupture into it of a tubercular prostatic abscess, or by the extension along the ducts to the urethra, and from there to the bladder. An ascending tuberculosis of the ejaculatory ducts in other cases precedes the bladder affection. A previous gonorrhœal cystitis not infrequently prepares the soil for tubercular infection. König observed a case in which a turpentine intoxication first produced active symptoms in a case of latent catarrhal tubercular cystitis caused by a tubercular kidney.

Although no age is exempt, tuberculosis of the bladder occurs most frequently in men between seventeen and forty years of age. Baudet records a case in a boy aged fifteen years; in this case the earliest point of invasion, so far as could be determined, was the testicle, then the prostate and bladder, thence along the ureter to the kidney. The writer has seen, in a girl aged nine years, a case of primary vesical tuberculosis that extended to both kidneys, and proved fatal in less than a year.

The two places in which tuberculosis of the bladder is most likely to commence are the ureteral orifices and the trigone of the bladder. The former starting-point of the disease is the rule when the bladder becomes involved by a descending tubercular ureteritis—that is, when the disease is secondary to renal tuberculosis; the trigone is usually the original seat of the disease in primary tuberculosis of the bladder, and in men also by the extension of the disease from the genital organs.

The tubercular disease here as elsewhere is characterized by the same chain of pathological changes—infiltration, caseation,

and ulceration. Penetration of the bladder-wall frequently leads to the formation of perivesical abscess and fistula formation, a part or all of the urine escaping through the fistulous opening. The chronic inflammation and the vesical tenesmus lead to great thickening of the wall of the bladder, sacculation, and diminished capacity of the organ. The extension of the tubercular inflammation over the surface and in the direction of the different tunics of the bladder wall is hastened in case the bladder becomes infected with pus microbes, which is so often the case, and which is so frequently caused by the needless use of instruments in the fruitless search for stone in the bladder, which a beginning vesical tuberculosis often mimics so closely. The complications most frequently encountered in post-mortem examinations of patients who have died of the direct or indirect effects of tuberculosis of the bladder are tuberculosis of the lungs, kidneys, genital organs, and peritoneum, and perivesical tubercular abscesses with or without fistula formation. The disease is initiated by a frequent desire to urinate and by pain after emptying the bladder, with slight hæmaturia at longer or shorter intervals. Urination becomes more frequent as the disease advances, and after the neck of the bladder has been reached incontinence of urine becomes a conspicuous clinical symptom. The urine exhibits the same appearance and contains the same morphological constituents during the early stages of the disease as in cases of chronic catarrh of the bladder. In the beginning of the disease the urine is acid and contains pus, bladder epithelia, and a small quantity of albumin. If the kidneys are affected at the same time, the albumin is more abundant. If secondary infection with pus microbes or saprophytic bacteria has occurred, it is alkaline in reaction and often ammoniacal, and then contains also a larger amount of mucus and pus-corpuscles and disintegrated red blood-corpuscles, besides the large flat epithelial cells from the bladder. As soon as the cheesy material on the surface of the bladder softens and disintegrates, fragments of detritus are found in the urine Tubercle bacilli are not always present, and their detection is often very difficult. Their presence can also be determined by

cultivation on artificial nutrient media and by inoculation experiments. If, in cases of suspected bladder tuberculosis, the bacillus cannot be found, the injection of a few drops of the urine sediment into the eye, a joint, the pleura, or the peritoneal cavity of a rabbit or guinea-pig, will often succeed in reproducing the disease, and upon the results of such experiments we must then base our diagnosis. The positive results of such experiments and the detection of bacilli in the urine do not enable us always to locate the disease anatomically; in other words, we must ascertain further whether the disease involves the kidney, the bladder, or the lowest portion of the urinary tract. Nitze's cystoscope is a useful diagnostic instrument in the hands of experts. Finally, it may be stated that in all chronic inflammatory affections of the urinary organs it is necessary to make careful and often repeated examinations, both of the general and local symptoms, for the purpose of locating the disease, as well as to determine its nature, which often can be done in a satisfactory manner only by making a microscopical and bacteriological examination of the urine; if this should still leave the diagnosis doubtful, a resort to inoculation experiments upon animals susceptible to tuberculosis becomes necessary as a decisive diagnostic test.

DISCUSSION.

Dr. W. S. Halsted, of Baltimore.

Dr. Hugh H Young, our assistant in genito-urinary surgery, who has done a great deal of work on the bacteriology of cystitis, believed that Melchoir's results are unreliable because all of his cultures from the bladder were taken by way of the urethra which so often lodges the bacillus coli communis, and hence were liable to contamination by this organism.

In all of Young's twenty-five or thirty cases the urine was obtained by suprapubic aspiration of the bladder. By this method the prevailing organism was the staphylococcus pyogenes albus. The possibility of contamination by skin organisms was excluded by control inoculations. The proteus was always present in ammoniacal urine. Young cultivated the gonococcus from neutral, acid, and alkaline urines.

Dr. S. Alexander, of New York.

I wish to express my gratification for the honor of being allowed to speak before the Association at this time and also of being present to hear this excellent paper. It is of extreme value, especially in calling attention to a subject which is almost entirely neglected by the general profession.

The first point I would like to refer to is in regard to the anatomy of the bladder, as I understood Dr. Senn to say that it was entirely devoid of glands, and that the mucous membrane was not like that in other situations; also that lymphatic tissue was absent. In a series of investigations made some years ago to study the amount of lymphatic tissue in the bladder, it was demonstrated that lymphatic tissue in the form of lymph nodules was a constant factor in almost every case both of the bladder and of the ureters. In certain conditions of infection these foci would take on a peculiar form of inflammation which we call a nodular cystitis. In addition to this we were struck with the number of cases in which there was not only a large number of simple follicular glands, which have been very thoroughly described, but were also impressed by the very large number of other glands. I think the impression that but two glands exist in the bladder will have to be modified in future researches. Furthermore, in recent investigations during the past eighteen months, especially in

the nature of prostatic enlargement, we have demonstrated that in a proportion of normal bladders in which we found the middle portion of the prostate enlarged, we also found scattered in the mucous membrane around the trigone, and in some instances extending above the trigone, numerous accessory prostatic glands. These unquestionably in certain forms of inflammation will modify the anatomical conditions, and I think we will have to pay more attention to the histological structure of the bladder. It seems to have been accepted as an established fact that we shall have to go into the study more thoroughly in order to make a more true classification. I should like to agree most heartily with what Dr. Senn has said in regard to the question of retention of urine. I think we have very few cases of inflammation of the bladder, except those as a direct extension of gonorrhœal infection, which are not the result of retention of urine. Cases of very moderate degree of stricture, or of very moderate prostatic congestion, as a result of sexual hyperæmia, will be found to have an appreciable amount of residual urine which may be measured in drachms or ounces, and in these cases cystitis may be developed.

I should like to say in regard to the question of traumatism, that the form of trauma which is very often overlooked is that which occurs as a result of destructive diseases, either as a result of stricture, or prostatic enlargement, or those brought about by the irregular catheterization of the patient. We have found that where a patient suffering with prostatic enlargement is catheterized with an absolutely and perfectly clean catheter, taking all the aseptic precautions possible, with the most careful lavage of the bladder, that it will become infected in spite of our aseptic precautions. If a man is catheterized at nine o'clock one morning, and then allowed to go until five or six in the afternoon, and then catheterized, and the next day is not catheterized until twelve o'clock, his bladder will become over-distended, and in this way trauma is produced. As a result the tissues are weakened by the over-distention, and infection takes place more rapidly. The avoidance of trauma as a result of simple carelessness is important.

Dr. Senn. I must apologize for the imperfect manner in which the subject was presented. I think Dr. Alexander misunderstood me, as I made reference to lymphatic glands in a separate part of the paper. It is known that the vesical mucous membrane itself has no lymphatic glands, which explains why septic substances are not absorbed from the bladder.

The experiments of Dr. Parmenter are interesting, but we cannot attribute the presence of ether in different parts of the body to absorption, as it might enter the circulation entirely by a process of diffusion. Very careful experimentation has shown this. In the urethra and the neck of the bladder there is absorption, but the vesical mucous membrane proper has no absorptive power.

THE QUESTION OF OPERATIVE INTERFERENCE IN RECENT SIMPLE FRACTURES OF THE PATELLA.

By CHARLES A. POWERS, M.D.,
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It is now twelve years since Dennis made his well-known report on this subject, at the close of which, in recommending open arthrotomy and osseous suture, he said:

"It will be for the future practice of surgery to pass a final verdict upon this method of treatment of fracture of the patella, after a study of the results obtained in the few years to come. . . . With the gigantic strides which modern surgery is making, it is safe to predict that in careful hands this operation will be devoid of every risk to life."

And recently this distinguished author, while continuing to adhere to operative interference, repeats:[1]

"While the number of cases yet operated upon is too limited to admit of deductions by means of which a final settlement of this question can be made in the minds of surgeons, the future practice of the surgery of this and of other countries will soon enable us to condemn it as an unsafe and unjustifiable procedure, or else it will be conceded as one of the grandest triumphs of our art."

It cannot be denied that the statistics of Dennis made but a poor argument in favor of open arthrotomy in recent, simple, transverse fractures. Bull,[2] in a consistent article opposing operative measures, said:

[1] Dennis's System of Surgery, vol, i. page 558.
[2] New York Medical Record, March 22, 1890.

"Of wiring the patella, it is needless to say that, while it made its entrance into practice by the advocacy of the pioneer in antiseptic surgery, Sir Joseph Lister, it has never received general support. . . . It is sufficient to know that death and disaster from amputation and suppuration and anchylosis have followed its performance in the hands of the many, and that we have no evidence that when, in the hands of the few, it has proven safe, the ultimate results have been better than those by non-operative methods."

The statistics of Brunner and Beck, which appeared at about the time of Dennis's article, also argued against arthrotomy and in favor of simple measures. But the past decade has brought advance in all departments of operative surgery. The field has steadily widened, and the improvements in aseptic technique have led to increased faith in the safety of operative procedure. Operative interference in simple fractures of the patella has increased in frequency rather than diminished. It numbers among its adherents many of the most distinguished of our profession, and it is the object of this inquiry to determine, so far as may be possible, what its true place is, and wherein lie its limitations, for that it has a place in surgery cannot be gainsaid.

In addition to the operative risks which attend any major procedure, certain anatomical conditions render the knee-joint an especially important field in the event of septic mischief. It is a synovial membrane wide in area, difficult of thorough cleansing, with many nooks and recesses. Infection once under way may spread with gread rapidity. Czerny, in a recent personal communication, says:

"I do not know why the danger in operations for fractured patella is greater than in many cases of laparotomy, but I feel that it is so." It may be that a rational explanation for this lies in the vastly greater lymphatic drainage which the peritoneum presents. In the highly advanced stage of our aseptic art the risk of infection in open arthrotomy of the knee may be a small factor at this day, but it is a constant one. The surgeon may be morally certain that his wound will pursue an

aseptic course; but he cannot be absolutely sure of this, and, as said, this danger, while slight, will yet be constant. In the consideration of the subject, then, two prominent conditions command our attention: the danger to life and limb and the value of the procedure as evidenced by improved ultimate results. For unless it can be shown that the latter outweigh the former, operation must fall to the ground."

The first of these conditions can at this time be estimated with a fair approach to accuracy. Enough cases are on record to enable us to judge well regarding the danger. But in the matter of ultimate results our conclusions must be in large part inferential, as with but few exceptions the cases have been reported too soon after operation. They are instances of operative recovery, and they permit an expression of the individual opinions of the reporters, but they unfortunately do not warrant judgment as to the definite usefulness of the limb after the lapse of a suitable length of time. We need definite reports on large series of cases from individual operators. The cases should be thoroughly tested after a lapse of one or two years, for in no class of fractures does time make greater changes. A patient presenting a good result and a highly promising condition at the end of two months may walk badly a year later, through stretching of the callus, while gradual muscular improvement may render the converse true. Tests should be made systematically, and should be both structural and functional. (Myles.)

(*a*) *Structural Tests.*—The patella may be examined as to union of the fragments by illumination by the Roentgen rays, by palpation by the fingers when the leg is extended and flexed and when the weight of the body is borne on that limb. Mobility of the patella, as a whole, is to be inquired into.

The joint is tested for arthritis by passive motion, and the state of the muscles may be a guide to this arthritis. Stiffness short of anchylosis and tending to wear off is indicative of a low grade of joint inflammation.

Atrophy of the muscles may be tested by mensuration, by

palpation, and by ability to contract under the fingers in response to electrical currents.

(*b*) *Functional Tests.*—Voluntary flexion and extension, ability to ascend and descend stairs, to dance and kneel, to raise the heel while lying on the back, to raise the heel from a high stool while standing erect on the opposite limb, to spring from the floor and to hop while standing on the affected leg only; ability to walk ordinary distances without early and unusual fatigue, and to pursue occupation when the latter be difficult.

Enough of these tests should be made to permit of judgment regarding the result after one or two years; but very few of the reported cases bear this examination.

The truest test as to result is the ability to walk long distances, to pursue arduous occupations, to easily ascend and descend stairs, and the like. This, in most instances, depends on preservation or restoration of the quadriceps femoris and absence of arthritis quite as much as on the condition of the patella itself. The union between the patellar fragments may be very close and the functional use of the joint poor, while numerous instances are recorded in which the fragments are separated by several inches, yet in which the limb is strong and useful. Rupture or preservation of the tendinous expansion of the vasti is of great importance in determining the result in these cases of marked diastasis.

While the union between the patellar fragments is generally spoken of as bony or ligamentous, there are so many recorded instances (Sayre, Stimson, Bogdanik) in which post-mortem examination has proved an apparently bony union to be fibrous that it would seem best to discard the term "bony union" and substitute "complete" and "incomplete;" the former to denote failure to obtain independent mobility of the fragments, while an incomplete union may mean a short or a long fibrous callus. True bony callus cannot stretch. While it may occur it is of such rarity that it need hardly engage our attention. Indeed, Pibrae (Coriton, Thèse de Paris, 1892), offered one hundred louis for positive proof of it. It matters not, however,

whether the callus be bony or fibrous, so long as the fragments be intimately joined and remain so.

Mechanism.—The majority of the cases are due to muscular action, the patient endeavoring to save himself from falling, the quadriceps femoris being strongly contracted at the time. While Brunner found but 17 per cent. of tear-fractures in the cases from Bruns' Clinic, and while Bähr[1] had observed eight cases of direct trauma in a total of twice the number, yet the weight of clinical evidence is much in favor of the preponderance of cases of muscular origin. Aside from the history given by the patient, often untrustworthy, the examination directly after the accident may aid in determining the nature of the injury. Wide separation of the fragments, with prolapse of the pre-patellar tissues into the breach, speaks for a muscular origin. Contusion fractures have less diastasis and less intervening tissue, hence, in these the prognosis is the better. Muscular action rarely causes fracture unless the knee is bent at the time. Here, as Macewen[2] has shown, the sudden development of the full retractive force of the powerful quadriceps causes the patella to be jerked upward, relatively to the femur, beyond the position where it usually lies supported laterally by the femoral patellar surface. The patella, being held below by the powerful ligamentum patellæ, rests on the apex of its posterior vertical ridge, which thus becomes the point upon which is developed the greatest contractive power of the quadriceps extensor on the one side and the weight of the body on the other. The patella is thus converted into a lever of the first order, and the strength of this lever not being sufficient to stand the strain, it gives way, and the transverse fracture of the patella is the result. Somewhat similar is the mechanism of the contusion fracture when the knee is bent. I think Bähr is correct when he says that the blow usually falls on the under half of the patella when the upper half is lying against the lower end of the femur. Thus the patella is broken off and not through.

With the vertical fracture, as well as with those which are

[1] Sammlung klin. Vorträge, 1894, No. 107.

[2] Annals of Surgery, vol. v. page 181.

complicated, or with rupture of the tendon of the quadriceps or of the patellar ligament, we have nothing to do in this article.

PATHOLOGY. In the fractures due to muscular action there are but two fragments. Of these the upper is generally the larger. The fractured surfaces are, as a rule, irregular, the line of fracture may be transverse or oblique. In the latter event it is apt to run from above and without downward and inward. At times but a shell of bone may be torn from the lower angle of the patella, leaving the bone itself practically intact. In the contusion fractures the lesion may be single or comminuted; not infrequently the latter, the so-called star-shaped fractures. These contusion fractures may be associated with fracture of one or other of the epicondyles of the femur; but this is of rare occurrence.

The fractured surfaces are generally fairly even. Chapius and Stoops each found a V-shape in the upper fragment, the lower being correspondingly grooved.

The fragments may lie in a normal plane or they may be turned or twisted. Crickx[1] thinks that ordinarily the fractured surfaces are turned toward the skin, and that this is due to the insertion of the rectus and the patellar tendon on the anterior surface of the bone. Howard Marsh found this condition in two out of ten of his recently operated cases, the fractured surface of each fragment looking anteriorly. Roswell Park found the fractured surfaces to be turned posteriorly in one of his operations.

Of the greatest importance, in these fractures, are the associated lesions in the capsules of the joint, the lateral tendinous expansions of the vasti, the so-called "ailerons" of the French writers. These tears are often met. Indeed Crickx says that they are almost invariably present when the diastasis amounts to 2 cm. The femoral aponeurosis is generally left intact. The pre-patellar bursa is torn and the synovial pouch is opened to a greater or less extent. The more extensive the lateral tears in the aponeurosis the greater will be the synovial lesion, and the

[1] Le Massage et la Suture Osseuse dans les Fractures de la Rotule. Bruxelles, 1896.

more complete is this synovial laceration the greater will be the accompanying hæmarthrosis, for more bleeding takes place from the very vascular synovial membrane than from the fractured surfaces themselves.

Riedel, of Jena, lost from chloroform a patient on whom he was operating for recent patella fracture. On continuing his examination he found a tear 2 cm. long in the upper part of the synovial pouch beneath the triceps and much extravasated blood beneath the muscles of the thigh. He attributed this tear to energetic contraction of the subcrureus muscle, the tensor of the synovial pouch. Klemm, of Riga, has made a similar observation. Fowler calls attention to this lesion as explaining the extension of suppuration from the knee-joint to the deep parts of the thigh, and other authors claim that blood thus extravasated may, by pressure and organization, lead to or add to atrophy of the thigh muscles.

Hemorrhage into the joint is always marked; it is more extensive in the muscular fractures and in those in which the fragments are widely separated, for, as said, in these cases the synovial membrane is more seriously lacerated. The organization of the clots leads to adhesions and arthritis.

The pre-patellar tissues fall into the breach. This is a matter of the greatest importance. First described by Macewen, later studied in detail by Hoffa, and since confirmed by all observers who have operated, there is now no room for doubt that the prolapse of the floor of the bursa and the aponeurotic fibres at the front of the patella is is of constant occurrence in all cases of fracture due to muscular action, while Phelps and other writers state that it is almost invariably found in the breaks due to direct violence.

Conditions Tending to Cause Imperfect Union. *Obstacles to Union.*—In seeking these we can most properly judge regarding measures which are calculated to attain the best possible results, for that ordinary results after fractured patella are far from perfect is admitted by all. These conditions may be enumerated as follows:

1. Separation of fragments. Due to
   a. Retraction of the upper fragment from contraction of the quadriceps femoris and a slight drawing down of the lower fragment through shortening of the ligamentum patellæ.
   b. Effused blood.
2. Tilting of the fragments (this may be present to a marked degree and unrecognizable without operation).
3. Rupture of the tendinous expansion of the vasti and of the lateral portions of the capsule of the joint.
4. Prolapse of pre-patellar tissues into the breach.
5. Atrophy of the quadriceps femoris, due to
   a. Disuse.
   b. Arthritis.
   c. Marked contusion of the muscle.
   d. Blood extravasated from the joint through the rent in the upper part of the capsule.
6. Arthritis of the knee-joint, this possibly resulting in
7. Adhesion of the patella.

Further, though of but little value, may be added

8. Natural poverty of the blood-supply to the bone (rendered negative by the fact that vertical fractures heal satisfactorily), and

9. Exceptional tendency to ostitis, seen in fat people, in the aged, and in certain conditions of the blood.

These factors may, perhaps, best receive consideration as we discuss the management of the fracture.

Non-operative Management. No better evidence of the unsatisfactory results attending treatment of fractured patella by mechanical means need be adduced than the great variety of plans and devices which have been set forth from time to time. Berger[1] has reckoned up no fewer than ninety-one different methods, and in the literature of more recent date I easily find enough to make the number over one hundred. It will suffice at this place to call attention to but three or four of these. First

[1] Dict. encyclo, de Méd. Coriton, Gazette des Hôpiteaux, 1892. lxv. p. 1349.

and best known, the general plan of making the closest possible approximation of the fragments, after subsidence of the joint swelling, by properly applied bandages or strips of sticking-plaster and then confining the limb on a splint or in a plaster-of-Paris dressing. Of the various posterior splints Agnew's is, perhaps, as suitable as any. In approximating the fragments, care is taken to see that they tilt as little as possible.

Millar, of Edinburgh, thought that the interposed aponeurotic tissues could be removed by friction, but this is improbable. Bony crepitus may indicate contact at one point only. Early aspiration of the joint effusion may succeed if done before the blood clots, but this clotting takes place early, and after it occurs the joint can only be emptied by a broad trocar and canula.

This, with or without irrigation, may well be thought almost as serious a procedure as open operation.

The use of Malgaigne's hooks, or of the modification by Levis or Otis or Duplay, as an aid to coaptation seems to have declined. Treves speaks well of them, and they are still used to a moderate extent in France. I have seen but little of the method, but do not judge that they give results superior to simple dressings.

The most valuable of the non-operative forms of management I take to be that of massage, the so-called "Dutch" method. Introduced by Tilanus, of Amsterdam, in 1885, this measure has had extensive trial, and all who have employed it speak well of it. A brief description is as follows: During the first twenty-four or forty-eight hours the limb is elevated and the joint compressed by an elastic bandage. On the second or third day the massage is commenced, and should be carried out by the medical attendant himself. The upper fragment is fixed by the fingers of one hand, while with the other gentle massage is made from the knee along the thigh muscles. If an assistant steadies the fragments both of the surgeon's hands can be used in this. Effleurage, or stroking of the knee, is made, and the muscles are kneaded. The leg should also receive attention. At first the seances should be from eight to fifteen minutes in

length, but the time may be increased as the days go by. The massage should be made twice daily; it will provoke pain in the early days, but this rapidly subsides. The degree of pain will perhaps govern the amount of the massage at first, but after a few trials the patient will experience a sense of comfort and relief. Between the massage seances the fragments are held in apposition by straps of plaster, and the limb is so elevated that the extensors of the thigh are relaxed and the return circulation favored. Passive motion is begun very early; it prevents adhesions, both intra-articular, between the torn or bulging synovial membranes and the capsule of the joint, as well as between the soft parts and the condyles of the femur. This passive motion should be progressive, but should not be carried to the point of causing marked pain. Further, the patient should be up and about on crutches early; by the eighth or tenth day. Two weeks later he discards the crutches and walks with two canes, later still with but one cane. In the average case the joint effusion will have disappeared by the end of the third week, and at this time the patient will be able to flex the leg to 135 degrees. By the fortieth day he will walk quite well. He is to wear a suitable check apparatus (one of the best of which has recently been described by Howard Marsh in the *British Medical Journal*) until flexion is beyond a right angle.

So far as the immediate results go, it is not difficult to see that the Dutch method is superior to other non-operative procedures, and while, as I have said, observers have generally reported their cases at too early a day, I am inclined to think that the remote results surpass those attained by the older methods.

Ham[1] reports twenty-one cases, a majority of which had been observed for one year. While it is difficult to get at the exact results, it is evident that nearly all had complete and strong extension, and flexion almost equal to that on the opposite side. In five out of the twenty-one cases there was complete union of

[1] De Voor en Nadeclen van de Behandlung, etc. Amsterdam, 1893.

the fragments, a percentage which is certainly above that attained by confinement methods.

Zum Bush[1] reports on eleven cases treated by the method of Tilanus. He let his patients get up and go about in a simple splint with a cane on the second day; all returned to work at the end of six weeks, at which time each could lift the leg from a high stool while standing on the opposite foot. The author does not give the amount of separation of the fragments nor the degree of flexion of the leg, but it must be admitted that the work-test is a satisfactory one and the results exceedingly good. I find report of numerous individual cases which confirm the value of the massage treatment (faradaism to the muscles may be an adjuvant in this), and can make no doubt that it is the most satisfactory and valuable of the non-operative methods of management. Aside from this I can find no statistics as good as those of Bull,[2] who reports on sixteen cases of recent fracture treated by plaster-of-Paris splint with appropriate confinement of the fragments, and observed by him at periods varying from one year and nine months to thirteen years after the date of the injury. Of these sixteen cases the ultimate result was excellent in fourteen, or 87½ per cent., and bad in two cases, or 12½ per cent. of the whole. Bull's cases seem to show but four in which the cause was clearly muscular action. The patients, for the most part, pursued arduous occupations after the injury. One was a metropolitan policeman, two were firemen, two truck-drivers, two laborers, two housekeepers, one a waiter. This form of treatment involves confinement for about six weeks, at the end of which time the patient can resume any amusement or occupation that can be carried on with a knee stiffened with a ham-splint. During the following three months much care must be exercised to prevent accidents. Without citing further references it may perhaps suffice for me to report that while the massage treatment entails arduous work on the part of the surgeon, a careful study of the subject convinces me that it yields the best results of any of the non-operative forms of manage-

[1] Centr. f. Chir., 1895, p. 449.

[2] New York Medical Record, March 22, 1890.

ment. Crickx, in an extended argument in favor of open suture, compares this only with massage, which latter method he takes as the type of the simpler forms of treatment.

Operative Treatment. So far as I am able to learn, the first operations for the cure of fractured patella were made by Rhea Barton and by McClellan, of Philadelphia. These were followed by Cooper, of San Francisco, in 1861, and afterward by Logan, Gunn, Cabot, Kuhne, Abridge, and Heine. The results varied, but were, on the whole, far from encouraging, septic processes being rife in all open wounds of this pre-antiseptic day. It was, therefore, reserved for the great Lister to deliberately place the operation on a plane commanding attention and respect. This renowned surgeon, with faith in his theory and practice of antisepsis, sutured a fractured olecranon in 1873, and at this time proposed to do the same with broken patellæ; but it was not until 1877 that he carried out this resolve, at that time submitting a freshly broken knee-cap to open arthrotomy and suture, the result being a marked success. In 1883 he presented seven cured cases to the London Clinical Society, and argued in favor of the procedure. The operation was essayed by other surgeons, but the risk attending it was acknowledged to be great, and it found but little favor. From time to time cases were exhibited, and the question was warmly argued for and against. Many modifications of the open arthrotomy of Lister were devised with a view to avoiding the dangers of sepsis; some of these sought to bring the fragments in contact without opening the joint.

In this country early, consistent, and progressive work was done at Bellevue Hospital in New York, and to Dennis, Stimson, Phelps, Fluhrer, and the other surgeons of that institution is due in large measure the advance in favor which the operation has made.

In estimating the place which it occupies in surgery to-day I have felt it of very great advantage to gain the personal opinions of a certain number of surgeons. With this view letters of inquiry were addressed to the active and honorary fellows of this Association, to the members of the New York Surgical Society,

and of the Philadelphia Academy of Surgery, these being purely surgical bodies.[1]

The queries embraced the general question as to advisability of operating on recent simple fractures; the form of operation preferred; the number of cases operated, with results; and the time at which, in average cases, patients could resume daily life either with or without operation. To these letters of inquiry ninety answers were received, and I beg at this time to express my gratitude to those who so kindly replied. The consensus of opinion therein expressed certainly represents fairly the judgment of the surgeons of our country.[2]

The following say that they have had insufficient experience in the matter, and thus refrain from expressing an opinion: D. P. Allen, E. H. Bradford, J. H. Brinton, P. S. Conner, N. P. Dandridge, J. McF. Gaston, C. L. Gibson, Reginald Harrison, W. W. Keen, Willy Meyer, G. H. Monks, E. M. Moore, J. H. Packard, J. Paget, and P. Syms; while L. B. Bangs, G. E. Shoemaker, H. A. Wilson, and V. P. Gibney have worked for some years in other directions than that of general surgery, and so decline to render judgment.

The remainder—seventy-one in number—make the following statements:

Robert Abbe: Would operate only when there is wide separation of the fragments with probable future displacement.

In operating prefers vertical incision, removal of interposed structures, circular patellar suture of heavy silk. Insists on operative removal of interposed fibrous structure. Has operated three times with excellent results. Thinks that general practitioners and most surgeons should refrain from operating.

Patients resume daily life in about three months with or without operation.

O. H. Allis: Would operate in cases in which there is comminution with hemorrhage into the joint, also in single fractures with wide separation of the fragments. Would do open arthrotomy.

[1] To these have been added the names of Drs. Phelps and Fluhrer, of New York, because of their well-known experience in the matter.

[2] While the answers are not reproduced in full, no important statements are omitted.

Would not operate in simple cases without much separation of fragments. Patients return to work in non-operative cases in about two months.

John Ashhurst, Jr.: Does not consider the operation justifiable.

J. M. Barton: Operates in cases due to muscular contraction. Open arthrotomy and silver wire. Two successful cases. "Would operate whenever aseptic conditions are within reach."

Operated cases resume daily life a little the earlier.

R. B. Bontecou: Has operated three cases—two satisfactory; one (comminuted) died from sepsis. In general prefers Malgaigne's hooks.

C. K. Briddon: Would operate only in cases in which the distention of the joint interferes with a reasonable approximation of the surfaces. Prefers vertical incision with free exposure, suture by heavy chromicised cat-gut or silver wire. Has operated two cases with satisfactory results. If massage is used patients resume daily life in from six to eight weeks, there being but little difference between non-operated cases and those submitted to operation.

F. Tilden Brown: Does not approve of operative interference.

J. D. Bryant: Has operated on nineteen cases; one died of delirium tremens a few days after the operation. "The others had limbs which, at the time of escape from observation, were in all ways progressing to a favorable and complete termination which bespoke a useful joint." Does not believe in operation as a general measure.

H. L. Burrell: Would operate in cases in which the fragments cannot be approximated or in those in which the patella has been the seat of multiple fractures. Prefers open arthrotomy by longitudinal incision with two or three buried wire sutures. Has operated on three cases with satisfactory results. Patients resume daily life in six months to a year in non-operated cases, and in six months in those submitted to operation.

A. T. Cabot: Refers to *Boston Medical and Surgical Journal*, November 19, 1891, in which he says: "It is the writer's feeling that in simple fractures of the patella the added risks of an opening into the joint are so great that the best treatment is by apparatus."

W. H. Carmalt: Employs subcutaneous suture with silkworm-gut in cases in which the fragments are not easily brought into close apposition. Has operated in four cases with satisfactory results. Non-operated cases return to work in three months and operated cases in six weeks.

N. B. Carson: Has operated in one case with resultant partial ankylosis. Would operate on selected cases.

D. W. Cheever: Does not believe it wise to resort to operative interference in any case of recent simple fracture of the patella, and thinks the results of non-operative treatment in ordinary cases sufficiently good to warrant a continuance of this form of management. The non-operated cases resume daily life in about three months, patients wearing a guard splint.

John Chiene: Does not operate. Gets excellent results from sticking-plaster suitably applied.

H. W. Cushing: Has never resorted to operation, but would do so in case the patient requested it after the facts had been fully explained to him. Prefers vertical incision, irrigation of joint, accurate suture of fragments and their coverings by silk or silver wire. In non-operated cases patients resume daily life in about eight weeks with support, and in from eight months to one year without support.

V. Czerny: Does not believe it wise to operate in recent, simple fractures because the risk of inflammation and ankylosis is too great. Does not know why the danger of inflammation in operations for fracture of patella is greater than in many cases of laparotomy, but feels that it is so.

Form of operation, open suture by silver wire.

Has operated one or two cases with resulting inflammation and ankylosis. Believes that with a separation of two to four centimetres the use of the limb is generally sufficiently good.

Non-operated cases return to work in from two to six months.

C. W. Dulles: "I do not think, taking advantages and risks together, that operation is wise. I think that one death or ruined joint in a hundred would determine this—and we have absolutely no statistics that we can trust to show how many operations have ended disastrously." Non-operated cases resume daily life in about three months.

G. G. Davis: Would operate in all cases in which the fragments cannot be brought almost or quite in contact by simple pressure. Has operated with satisfactory results in about six cases.

Non-operated cases resume daily life at the end of two months, but wear protective apparatus for a year. Operative management shortens the treatment, the wire allows use of bone by preventing refracture. Passive motion is safe as soon as the wound is soundly healed, say, at the end of three or four weeks. The joint limbers up sooner and the patient can resume work safely without apparatus.

J. B. Deaver: Employs posterior splint (Agnew) with adhesive straps where fragments easily fall together. In case they do not well appose he uses Malgaigne's hooks.

F. S. Dennis: Operates when the patient is perfectly healthy, when separation of fragments is wide, when time is of great importance, when both patellæ are fractured; uses silver-wire suture. Has operated 30 cases; satisfactory results in 29. Believes the cases for wiring should be very carefully selected; the viscera should be healthy and absolute asepsis is imperative.

W. F. Fluhrer: Would operate in all cases in which no contra-indication exists. Uses silk or catgut suture, but would be prepared to employ silver wire if necessary. Drills fragments and approximates, after thoroughly washing out the joint. Does not consider results in non-operative cases sufficiently good. Has operated on 30 cases with satisfactory results.

G. R. Fowler: Would operate when fracture is due to indirect violence with a decided separation of the fragments. The operation should be intermediate, after subsidence of the primary coincident effects of the injury on the soft parts and before ligamentous union has taken place, or as a secondary operation; never as a primary operation.

Employs open arthrotomy with suture of capsule when fragments can easily be apposed—otherwise suture fragments with aseptic kangaroo tendon. Has operated 38 cases; satisfactory results in 30, suppuration in 7, death in 1. It should be said of the seven suppurative cases that six occurred in patients in whom the operation was performed as primary procedure. There were thirteen of these primary operations, therefore suppuration occurred in nearly 50 per cent. Of the twenty-five intermediate or secondary operations, infection occurred in but one, and in this was traced to the catgut. Non-operated cases resume work in six weeks, those submitted to operation in eight and one-half weeks.

B. B. Gallaudet: Operates in all cases in which there is a separation of the fragments to the extent of one-quarter of an inch or more. Employs curved incision and wiring. Has operated in seven cases: satisfactory results in six, suppuration in one.

Patients return to work in three or four weeks in non-operated cases, and in about eight weeks in those submitted to operation.

G. W. Gay: Would operate in young or middle-aged patients who are in good health and obliged to earn a living. Prefers open arthrot-

omy and wire suture. Has operated several cases with satisfactory results. Both non-operated cases and those submitted to operation resume daily life at the end of three or four months.

"I give you my conclusions based upon a moderate experience and a larger observation. It is not proved to my satisfaction that the operative cases are ultimately any better off than are those not subjected to operation. There are good and bad results from both methods of treatment. It is a safe operation, and the immediate result is first class in the large majority of cases, even if there be some suppuration, though I have never had infection. I have seen the fragments pulled apart at the end of four months and the fracture do well under a second wiring."

A. G. Gerster: Operation rarely needed. Has employed simple suture with stout catgut in three (satisfactory) cases. Non-operated cases resume daily life in six weeks, those subjected to operation in two months.

C. Gussenbauer: Has treated twenty-five to thirty cases of patella fracture. Four times has made suture; in the other cases uses what he calls "dry, not bloody suture" with good results. Has always considered the open operation indicated only in comminuted fractures with much separation of the fragments.

W. S. Halsted: Operates all of his own cases. Perfect result in fifteen. No suppuration, no drainage. In the hands of competent surgeons operation yields the best results. Only those sure of asepsis should operate.

R. H. Harte: Prefers Malgaigne's hooks when any form of operative interference is necessary. Would use them when the fragments cannot be well approximated without.

F. Hartley: Operates in cases in which the fragments cannot be well apposed by straps. Open arthrotomy, catgut suture of fragments and of aponeurosis of vasti.

Has operated twenty-seven cases. Twenty-three were satisfactory, in the other four cases the adhesions were so marked as to render the result unsatisfactory. Under either form of management patients resume daily life in from six to eight weeks.

J. Homans: Uses silk suture to fascia and periosteum. Satisfactory result in two cases. In the average case non-operative treatment is sufficiently satisfactory. Both operated and non-operated cases resume work in about three months.

W. Barton Hopkins: Obtains such good results from a special (*Annals of Surgery*, 1895, p. 682) appliance that he is less and less inclined to operate. Might operate in young, healthy subjects with wide (one and one-quarter inches) diastasis. Non-operated cases resume work in about three months.

Victor Horsley: Would wire in every case unless there are especial contraindications. Has operated in a number of cases. Suppuration in one; acute, gouty, bursitis patellæ in one; wire caused irritation and had to be removed in one case. Does not treat any cases without operation. Patients return to work in about six weeks.

O. Horwitz: Would operate in cases in which the fragments cannot be apposed. Prefers Barker's operation with subcutaneous suture, but in comminution would do open arthrotomy, uniting fragments with silver wire. Has operated in eight cases with satisfactory results; in five by Barker's method, and in three by open arthrotomy. In one case a silver suture ulcerated through the skin five months after operation. Patients resume daily life in from eight to ten weeks in non-operated cases, and in about the same length of time in those submitted to operation.

Ralph H. Isham: Does not operate in any cases. Non-operated patients resume daily life in about three months.

T. Kocher: Operates in all cases in which the fracture is transverse, with diastasis by laceration of the capsule on both sides of the patella. Has operated in twenty-four cases; satisfactory result in twenty-two, suppuration and stiffness in one, death in one. Employs longitudinal incision with direct suture of the fragments or of the soft parts. Operated cases resume daily life much sooner than those not subjected to operation.

"I think it quite essential that the distinction should be made between cases with and without diastasis—that is, with largely torn soft parts and with more or less intact fascia and capsule. Where there is no diastasis the best plan is massage with or without puncture of the joint. Where there is great diastasis I think actually we should always perform the operation, as the time is over when there was a risk of infection and its consequences. Many cases of suppuration, stiffness, and death are of the first I operated upon long ago."

L. C. Lane: Would operate in all cases in which the fragments are extensively separated. Prefers open arthrotomy by transverse incision, removal of clots, trimming off of ligamentous shreds, suture of frag-

ments by kangaroo tendon. Has operated in three cases with satisfactory results. In one of these there was slight extra-articular suppuration under one portion of the flap. In all of his cases treated by non-operated methods many months were required to reach moderate restoration of function, while in those submitted to operation the use of the joint was regained much earlier.

R. G. Le Conte: Would resort to open arthrotomy and wiring when the joint is greatly distended with blood and the fragments cannot be brought together. Non-operated cases resume daily life in from ten to twelve weeks.

H. Lilienthal: Prefers Dutch method of massage. "An office or quiet in-door occupation can be followed during treatment. Functional results perfect, even to hopping on the injured leg. Cure in six weeks. Treatment requires daily supervision and work by surgeon himself." Has operated one case; satisfactory result.

Lord Lister: "I may say that operative interference in recent transverse fracture of the patella was in my hands uniformly satisfactory in its results, and that in my opinion it should always be resorted to, provided always that the surgeon can reckon with confidence on the wound following an aseptic course."

A. J. McCosh: Would operate in (*a*) cases in which it is impossible to approximate the fragments within one-third inch of each other; (*b*) in cases of repeated fracture of the same patella; (*c*) in those in which bony union is especially desirable on account of the occupation of the patient. He unites the fragments with sutures of chromicized catgut or silver wire, and has operated in two cases with satisfactory results.

T. A. McGraw: Has never operated in cases of recent, simple fracture, and thinks the cases requiring operation very rare. In such cases would prefer silver-wire suture. Non-operated cases resume daily life in about three months.

C. H. Mastin: Has had very good results follow ordinary management, and has not met a case which, in his opinion, required operative procedure.

S. Marks: Does not recommend operative interference in any case of recent, simple fracture of the patella. In non-operated cases patients resume daily life in from eight to twelve weeks.

J. Ewing Mears: "Regarding the patella as a sesamoid bone, I regard its fracture as incidental to a rupture of the important ligament

in the folds of which it is embraced, and, therefore, believe that the ligament should be the important structure to be treated, and attempts to secure union between the fragments of the bone to be regarded as of secondary importance. Having observed that the disability in a large number of cases of non-union and of separation to a greater or less extent of the fragments was not very great, I have even advocated in some instances the removal of the fragments and the suturing of the divided ends of the ligament. I dwell particularly upon the marked differences in the symptoms and conditions following fracture of the patella when it occurs, on the one hand as the result of muscular contraction, and, on the other hand as the result of violence or force applied directly. In the first instance there is rupture, tearing and stretching of the fibres of the ligament, thus producing the separation of the fragments of the bone, which at the same time yields to the force which separated the structure of the ligament. In the second, where the force is applied directly, the bone encased in the ligament may be fractured, the fibres of the ligament contused, but not ruptured or stretched, and, as a result of these conditions, there is no separation of the fragments. I think we may correctly conclude from these facts that the ligament is the essential factor or agent, and that the bone plays a secondary part. Hence I believe that the expression 'fracture of the patella' may be abandoned or removed from surgical nomenclature. Hence, also, I believe that treatment should be applied to very strong and firm suturing of the ligament, as well as the wiring of the bone if it is allowed to remain *in situ*.

"In treating fractures of the patella, so called, by the older methods I have insisted upon rest in bed and with plaster and splint applications for a period of three months, and have also insisted on non-use of the limb for a period of three months after getting up from bed. By this treatment I have gotten very firm union of the lacerated fibres or bone, I care not which. I have found that this treatment gave good permanent results." Number of cases operated not given, all said to be satisfactory.

J. A. Moore: Operates in healthy subjects who desire it after the entire matter has been explained. Employs open arthrotomy with wiring. Has operated in five cases with satisfactory results. Operated cases resume daily life in six weeks, non-operated in three months.

T. G. Morton: Would operate whenever it is impossible to bring the fragments in close apposition. Uses heavy catgut suture. Has

operated on a number of cases without trouble; thinks there is no danger in the procedure.

Patients resume work in about three months with or without operation.

F. W. Murray: Is content with simple forms of management and decidedly opposed to operative procedures.

C. B. Nancrede: Would operate only in cases in which the opposite patella had been fractured, the patient young, and the operation managed by an expert in asepsis. Non-operated cases resume daily life in about three months.

J. E. Owens: Has operated on all cases during the past five years. Has operated six cases, suppuration in one, death in one. Both of these latter cases had multiple injuries.

"I have operated of late because of the trouble experienced in consequence of portions of the capsule dipping down between the fragments and preventing union."

J. H. Packard: Has had no experience with operative measures, has always obtained excellent ultimate results from the use of ordinary non-operative methods or from Malgaigne's hooks. Does not condemn operative management if thoroughly aseptic.

Roswell Park: Would use wire suture and would operate in healthy subjects, providing the surroundings were satisfactory. Does not consider non-operative management satisfactory. Has operated on ten cases with good result in each. Operated cases resume daily life in eight weeks, non-operated cases in fourteen to sixteen weeks.

C. Phelps: Would operate in all cases in which there is no general contra-indication. Has operated on 104 cases, with satisfactory result in 98, superficial suppuration with more or less false ankylosis in six. Says he has had bony union in all cases. Washes joint out thoroughly and considers operation absolutely safe with proper aseptic precautions.

L. S. Pilcher: Would operate in all transverse fractures when the patient can be treated in a hospital with well-organized aseptic operating facilities. Prefers longitudinal incision with trimming away of fibrous fringes and approximation of fragments by chromic-gut suture to aponeurosis of capsule. Has operated with satisfactory results in fifteen cases. Does not think the results of non-operative treatment sufficiently satisfactory when requisite experience and facilities for aseptic operative work can be secured. In non-operated cases patients

resume daily life in about twelve weeks, in those submitted to operation in four weeks.

C. B. Porter: Is convinced that wiring shortens the period of convalescence by two-thirds. Has operated on seven cases, very satisfactory result in each. Operation should be done only by a skilled surgeon.

W. G. Porter: Operates in no instance. Non-operated cases resume work in from four to six weeks.

T. F. Prewitt: Has never met with a case of recent, simple fracture in which he thought it advisable to operate. Removes splint in three months, and enjoins caution in use of limb until the end of six months.

J. Ransohoff: Would not operate in the vast majority of cases. Extensive hemorrhage into joint might justify operation.

M. H. Richardson: Has not operated in recent cases. Thinks the result in the average case to be sufficiently satisfactory without operation. Patients resume daily life in six months in non-operated cases, and does not think that operated cases should return to work much earlier. Intends to operate on future cases in which the separation of fragments is wide.

J. B. Roberts: Would operate on all cases in which the separation of fragments is not easily overcome by pressure straps of adhesive plaster. Prefers Levis's modification of Malgaigne's hooks. Has never resorted to open arthrotomy in recent, simple fractures. Thinks patients return to work in from six to eight weeks with the knee-joint extended in non-operative cases, and probably a little earlier in those in which the hooks are used.

L. A. Stimson: Would operate in practically all cases in which skilled assistance can be had. The exceptions are recent fractures by direct violence (comminuted and without separation of fragments), and in some cases in which the separation is but slight. Prefers longitudinal incision with mediate suture through tendon of quadriceps and ligamentum patellæ crossing in front of bone, or suture of fibro-periosteum at seat of fracture. Has operated seventy cases, with satisfactory result in each. Does not advise operative interference except with the aid of trained assistants and under most rigid aseptic conditions. In the operation done by him nothing but instruments touch the wound, thereby the risk of inflammation is less.

In cases submitted to operation patients get about in plaster splint

after ten days, wear it for about a month, and return to hard work on the feet at the end of two or three months. Now uses catgut as periosteal suture.

"As to ultimate results, I have seen but few patients after the third month; at that time all could, with one exception, flex to a right angle. Some, at a much later date, had full flexion. A few have come back with refracture from forced flexion while the joint was still stiff."

N. Senn: Does not advise operation in recent uncomplicated cases.

L. M. Tiffany: Operates when the fragments are widely separated and when there is much distention from joint extravasation. Selects healthy subjects of suitable age. Uses longitudinal incision, with suture of fibrous capsule and wiring of bone if necessary. Has operated in four instances with satisfactory results. Would not operate in ordinary cases. Thinks patients can return to work rather earlier when subjected to operation.

W. W. Van Arsdale: "Would operate in healthy, strong individuals under forty years. Operation—open incision, Fluhrer's drill, two silver wires not penetrating the joint." One case, satisfactory result. Patients able to resume work in eight weeks with operation, three months with massage, and one year with splints only. Believes refracture to take place quite as readily after operation as in cases treated by massage or splints.

A. Vander Veer: Believes non-operative methods sufficiently satisfactory in average cases. Has had no experience with operative methods. Patients resume daily life in seven or eight weeks under either form of management.

J. C. Warren: Does not think the results of non-operative management sufficiently good in average cases. Applies animal suture to periosteum and fascia. Has operated in three cases with satisfactory results. Non-operated cases resume daily life in about six months; those submitted to operation in about three months. Has used wire suture with satisfactory result, but, as said, prefers animal suture of periosteum and fascia.

F. S. Watson: Would operate in cases in which there is but little or no comminution, in those in which neither the upper nor the lower fragment is so small as to make it impossible for sutures to hold, and in cases in which there is evidence of considerable effusion of blood into

the joint. Has operated in two cases with satisfactory result in each. In non-operated cases patients resume daily life in from three to four months, while in those submitted to operation six weeks to two and one-half months suffice.

S. H. Weeks: Would not operate in any case of recent simple fracture. In non-operated cases patients resume daily life in about three months.

R. F. Weir: Does not think it proper to operate in any case.

H. R. Wharton: Operates only in exceptional cases; uses heavy silver wire. In average case non-operative management is satisfactory. Patients resume work in eight weeks without operation; a little sooner with operation.

J. W. White: Operates in all cases in which there is separation of the fragments. Employs Barker's operation, and has had satisfactory results in fifteen cases. Operated cases returned to work in three to four weeks; non-operated cases in from eight to twelve weeks.

G. Woolsey: Operates in cases with wide separation of fragments and those in which massage and elastic compression do not satisfactorily reduce the infusion and allow the approximation of the fragments in a reasonable length of time. Applies absorbable suture to fibrous tissues at edges of fragments. Has operated four cases with satisfactory results. In average cases massage and passive motion from the start give excellent results. Non-operated cases treated by massage and passive motion return to work in five or six weeks, and cases submitted to operation do not regain functions as rapidly. His non-operated cases get either bony union or such a close fibrous union that it is impossible to distinguish.

J. A. Wyeth: Is not an advocate of open operation in any case of recent, simple fracture, but might consider the propriety of it in certain rare instances where the individual must of necessity have restoration of function within two or three months after the accident. In ordinary cases non-operated management requires about eighteen months of careful guarding of the knee from over-flexion before there is complete and safe restoration of function. After two or three weeks' confinement to bed, patients are allowed to go about with a protective splint.

NOTE.—Since the preparation of this paper I have received replies from Dr. J. D. Rushmore, of Brooklyn, who expresses a preference for Malgaigne's hooks; from Dr. Max Schede, of Bonn, who does not

operate, and from Dr. De Forest Willard, of Philadelphia, and Dr. R. Matas, of New Orleans, who operate in exceptional cases.

SUMMARY. The following would use Malgaigne's hooks in suitable cases where the fragments cannot easily be approximated: R. B. Bontecou, J. B. Deaver, R. H. Harte, and J. B. Roberts. 4.

The following express themselves as opposed to operation in any case: J. Ashhurst, Jr., F. T. Brown, A. T. Cabot, D. W. Cheever, J. Chiene, V. Czerny, C. W. Dulles, R. H. Isham, H. Lilienthal, C. H. Mastin, S. Marks, F. W. Murray, W. G. Porter, T. F. Prewitt, N. Senn, S. H. Weeks, and R. F. Weir. 17.

The following would operate in all cases in which no distinct contraindication exists and in which the surroundings are satisfactory: W. F. Fluhrer, W. S. Halsted, Victor Horsley, T. Kocher, Lord Lister, J. E. Owens (practically), Roswell Park, C. Phelps, and L. S. Pilcher. 9.

The following would operate on selected cases, those with wide diastasis, comminution, etc.: Robert Abbe, O. H. Allis, J. M. Barton, C. K. Briddon, J. D. Bryant, H. L. Burrell, W. H. Carmalt, N. B. Carson, H. W. Cushing, G. G. Davis, F. S. Dennis, G. R. Fowler, B. B. Gallaudet, G. W. Gay, A. G. Gerster (rarely), C. Gussenbauer (rarely), F. Hartley, J. Homans, W. Barton Hopkins (rarely), O. Horwitz (Barker's operation), L. C. Lane, R. G. Le Conte, A. J. McCosh, T. A. McGraw (rarely), J. Ewing Mears, J. A. Moore, T. G. Morton, C. B. Nancrede (rarely), C. B. Porter, J. Ransohoff (rarely), M. H. Richardson, L. A. Stimson, L. M. Tiffany, W. W. Van Arsdale, A. Vander Veer (rarely), J. C. Warren, F. S. Watson, H. R. Wharton (rarely), J. W. White (Barker's operation), G. Woolsey, J. A. Wyeth (rarely). 41.

ANALYSIS. Analysis of these opinions on the general ground of the advisability or non-advisability of operation would show 17, or $23\frac{6}{71}$ per cent., as deliberately opposed to it, 9, or $13\frac{1}{71}$ per cent., as urging it in all cases in which no contraindication exists and in which competent surgical skill can be rendered

amid suitable surroundings, and 41, or $36\frac{35}{71}$ per cent., as recommending arthrotomy and suture in selected cases, such as those having wide diastasis, comminution, extensive joint distention, etc., while 4, or $5\frac{45}{71}$ per cent., favor the use of Malgaigne's hooks. Of the total number, then, over 70 per cent. favor operation in some cases. A procedure which numbers so many supporters must certainly be said to have an established place in surgery, and we may, therefore, proceed to the consideration of its dangers, limitations, methods, and results.

Dangers. In addition to the general risks attending any operative procedure of this nature, the danger from anæsthesia, bronchitis, pneumonia, nephritis, and the like, we have the risk of sepsis from infectious arthritis. In order to estimate as accurately as possible the mortality, I lay before you tables showing the cases which I am able to gather since the publication of Dennis's paper. These number 711, of which 474 came to me in personal communications, while 237 are collected from published papers.

Those personally communicated represent accurately the work of the surgeons who favor me with them, and must be acknowledged as presenting valuable statistics. The cases gathered from literature are all to which I have been able to gain access. This latter table is doubtless incomplete, but much effort has been made to render it accurate, and it is thought that no cases have been duplicated. For purpose of comparison the operations for recent simple fracture have been taken from Dennis's paper and placed in a separate class. It will be remembered that this paper of Dennis dealt with compound fractures as well as with those of long standing. I am indebted to Dr. Hobart E. Warren, of Denver, for his careful compilation of these tables, which are as follows:

TABLE A.—CASES FROM DENNIS'S TABLE.

Beauregard.	1 case;	result satisfactory.	
Bernays.	1 "	"	"
Bloxam, A.	3 cases;	"	"
Bryant.	1 case;	"	"
Bull.	2 cases;	"	"
Cameron.	2 "	"	" in 1; marked stiffness and disability, 1.
Colley.	1 case;	result satisfactory.	
Dennis.	5 cases;	"	" in 4; 1 died of delirium tremens and Bright's disease.
Finke.	1 case;	result satisfactory.	
Fluhrer.	1 "	"	"
Fowler.	1 "	died of carbolic acid poisoning	
Hardie.	4 cases;	result satisfactory.	
Hinton.	1 case;	result satisfactory.	
Jessop.	2 cases;	"	"
Katzenmeyer.	2 "	"	"
Keyes.	1 case;	"	"
Koenig.	3 cases;	marked stiffness and disability.	
Lammiman.	1 case;	result satisfactory.	
Langenbeck.	1 "	died of pyæmia.	
Langenbuch	1 "	result satisfactory.	
Lauenstein.	1 "	"	"
Lediard.	1 "	"	"
Lister,	5 cases;	"	"
Lynch.	2 cases;	result satisfactory.	
MacEwen.	2 "	"	"
McBurney.	1 case;	"	"
Phelps.	3 cases;	"	"
Pozzi.	1 "	marked stiffness and disability.	
Ranke.	1 "	marked stiffness and disability.	
Rivington.	1 "	result satisfactory.	
Rose.	3 cases;	"	" in 2; marked stiffness and disability in 1.
Rosenbach.	2 cases;	result satisfactory.	
Schede.	1 case;	complete ankylosis.	
Schneider.	1 "	result satisfactory.	
Smith, J.	1 case;	marked stiffness and disability.	
Smith, S.	3 cases;	result satisfactory.	
Socin.	1 case;	"	"
Timme.	1 "	"	"
Trendelenberg.	1 "	"	"
Van der Meulin.	3 cases;	"	"
Wahl.	1 case;	"	"
Walsh.	1 "	"	"
Wright.	2 cases;	"	"
Wyeth.	1 case;	amputation.	
Total,	75 cases.		

Satisfactory result, 62, or 82+ per cent.; marked stiffness or disability, 8, or 10+ per cent.; complete ankylosis, 1; amputation, 1; deaths, 3, or 4 per cent.

TABLE B.—CASES PERSONALLY COMMUNICATED TO THE AUTHOR.

Abbe, Robert.	3 cases;	open arthrotomy;	result satisfactory.			
Barton, J. M.	2 "	"	"	"	"	
Briddon, C. K.	2 "	"	"	"	"	
Bontecou, R. B.	3 "	"	"	"	"	in 2; 1 died of sepsis.
Bryant, J. D.	18 "	"	"	"	"	in 17; 1 " delirium [tremens.
Burrell, H. L.	3 "	"	"	"	"	
Carmalt, W. H.	4 cases;	result satisfactory.				
Czerny, V.	2 cases;	open arthrotomy;	marked stiffness and disabilty in 2.			
Carson, N. B.	1 case;	"	"	"	"	" " in 1.
Davis, G. G.	6 cases;	open arthrotomy;	result satisfactory.			
Dennis, F. S.	25 "	"	"	"	"	
Fluhrer, W. F.	30 "	"	"	"	"	
Fowler, G. R.	37 cases;	open arthrotomy;	result satisfactory in 30; marked stiffness and disability in 7.			

Gallaudet, B. B.	7 cases; open arthrotomy; result satisfactory in 6; marked stiffness and disability in 1.
Gerster, A. G.	3 cases; open orthrotomy; result satisfactory.
Gussenbauer, C.	4 " " " " "
Halsted, W. S.	15 " " " " "
Hartley, F.	27 cases; open arthrotomy; result satisfactory in 23; marked stiffness and disability in 4.
Homans, John	2 cases; open arthrotomy; result satisfactory.
Horwitz, O.	3 " " " " "
	5 cases; Barker's method; " "
Kocher, T.	24 cases; open arthrotomy; result satisfactory in 22; marked stiffness and disability in 1; death from sepsis 1.
Lane, L. C.	3 cases; open arthrotomy; result satisfactory.
McCosh, A. J.	2 " " " " "
Moore, J. A.	5 " " " " "
Owens, J. E.	6 cases; open arthrotomy; result satisfactory in 5; 1 died; both patellæ operated; multiple injuries. "The patient did not die solely because of the suppuration in the knee-joint."
Park, Roswell.	10 cases; open arthrotomy; result satisfactory.
Phelps, C.	101 cases; open arthrotomy; result satisfactory in 95; marked stiffness and disability in 6.
Pilcher, L. S.	15 cases; open arthrotomy; result satisfactory.
Porter, C. B.	7 " " " " "
Stimson, L. A.	70 " " " " "
Tiffany, L. M.	4 " " " " "
Van Arsdale, W. W.	1 " " " " "
Warren, J. C.	3 " " " " "
Watson, F. S.	2 " " " " "
White, J. W.	15 cases; Barker's method; result satisfactory.
Woolsey, George.	4 cases; open arthrotomy; " "
Total,	474 cases; satisfactory result, 448, or 94+ per cent.; marked stiffness and disability, 22, or 4+ per cent.; deaths, 4, or 0.84 per cent.

Table C.—Cases Gathered from Literature since the Publication of Dennis's Paper.

Butlin. St. Barth. Hosp. Journ., 1887. 4 cases; open arthrotomy; satisfactory result.

Kesteven. Lancet, 1887, vol. ii. p. 259. 1 case; open arthrotomy; satisfactory result.

Macewen. Annals of Surgery, 1887, vol. v. p. 177. 1 case; open arthrotomy; marked stiffness and disability.

Rhoades. Med. Press and Circular, 1887, vol. ii. p. 371. 3 cases; open arthrotomy; satisfactory result.

Ranneft. Nederl. Tijdosche. v. Geneesk., 1887. 1 case; open arthrotomy; satisfactory result.

Bloxam. Lancet, 1888, vol. i. p. 621. 1 case; open arthrotomy; satisfactory result.

Buchanan. Med. and Surg. Reporter, 1888, vol. lix., p. 399. 1 case; open arthrotomy; satisfactory result.

Ceci. Deutsche Zeitschrift für Chir., Bd. xxviii. p. 245; Centlbl. für Chir., 1888, p. 464. 5 cases; open arthrotomy; satisfactory result.

Pochhammer. Deutsche Militärarztes Zeitschr., 1888, Bd. xviii. p. 442. 1 case; open arthrotomy; satisfactory result.

Wight, J. S. Brooklyn Med. Journ., 1888, vol. i. p. 112. 2 cases; open arthrotomy; satisfactory result.

Armstrong. New York Med. Journ., 1889, vol. l. p. 174. 1 case; open arthrotomy; satisfactory result.

Beck. St. Petersburg Med. Wochen., 1889, p. 48. 3 cases; open arthrotomy; marked stiffness and disability.

Fridge. New Orleans Med. Journ., 1889–90, n. s., vol. xvii. p. 102. 1 case; open arthrotomy; satisfactory result.

Leahy. New Zealand Med. Journ., 1889–90, vol. iii. p. 162. 2 cases; open arthrotomy; satisfactory result.

Parkes. Archiv für klin. Chirurg., 1889, p. 447. 1 case; open arthrotomy: satisfactory result.

Poland. Lancet, 1889, vol. ii. p. 1230. 1 case; open arthrotomy; satisfactory result.

Rickering. Brit. Med. Journ., 1889, vol. i. p. 410. 1 case; open arthrotomy; satisfactory result.

Tachard. Bull. et mém. de la Soc. de Chir. de Paris, vol. xv. p. 371. 1 case; open arthrotomy; satisfactory result.

Macewen. (Pilcher) Amer. Surg., 1890, vol. xii. p. 400. 8 cases; open arthrotomy; satisfactory result.

Smith, S. Idem. 8 cases; open arthrotomy; satisfactory result.

Stankiewicz. Przegead lekarski, 1890, No. 5; Cent. f. Chir., 1890, p. 23. 4 cases; open arthrotomy; satisfactory result.

Caesari. Gazzo de Ospit, 1891, vol. xvi. p. 633: Cent. f. Chir., 1892, p. 72. 1 case; open arthrotomy; satisfactory result.

Croft. Lancet, 1891–92, p. 177. 2 cases; open arthrotomy; satisfactory result.

Monod. Bull. et mém. de la Soc. de Chir. de Paris, vol. xvii. p. 798. 1 case; open arthrotomy; satisfactory result.

Reclus. Idem, p. 706. 1 case: open arthrotomy; satisfactory result.

Barker. Brit. Med. Journ., 1892, vol. i. p. 425. 5 cases; Barker's method; satisfactory result.

Gibb. Idem, vol. ii. p. 791. 1 case; Barker's method; satisfactory result.

Berger. Bull. et mém. de la Soc., etc., vol. xviii. p. 563; 1 case; open arthrotomy; satisfactory result.

Page, H. W. Trans. Clin. Soc. London, 1892, vol. xxvi. p. 224. 1 case; Barker's method; satisfactory result.

Müller. { Schönborn, Inaug. Dlss., Königsberg, 1889. / Mickulicz, Cent. f. Chir.. 1892, p. 414. } 13 cases; open arthrotomy; satisfactory result.

Velo. Rif. Med., 1892, vol. iv. p. 74. 1 case; open arthrotomy; satisfactory result.

Cowell. Clin. Journ. London, 1893–94, vol. iii. p. 394. 5 cases; Butcher's method; satisfactory result in 4; complete ankylosis 1.

Ballance. Trans. Med. Soc. London, 1894, vol. xvii. p. 341. 6 cases; open arthrotomy; satisfactory result.

Mahr. Inaug. Diss. München, 1894; Cent. f. Chir., 1894, p. 989. 1 case; died of pulmonary embolism due to thrombosis of femoral vein.

Cant. Quar. Med. Journ., Sheffield, 1895–96, vol. iv. p. 42. 3 cases; open arthrotomy; satisfactory result.

Trendelenberg. Beiträge zur klin Chir., xii.; Cent. f. Chir., 1895. 20 cases; open arthrotomy; satisfactory result in 19; complete anchylosis 1

Lenger. Cf. Mon. A. Crickx. 23 cases; open arthrotomy; satisfactory result.

Crickx, A. Monograph, Le massage et la suture osseuse dans les fractures de la rotule, 1896, Bruxelles. 4 cases; open arthrotomy; satisfactory result.

Desguin. Idem. 6 cases: open arthrotomy; satisfactory result in 4; marked stiffness and disability in 1; 1 died of tuberculosis of knee-joint.

Gallet. Idem. 1 case; open arthrotomy; died of delirium tremens.

Lavisé. Idem. 4 cases; open arthrotomy; satisfactory result in 3; marked stiffness and disability in 1.

Van Engelen. Idem. 1 case; open arthrotomy; satisfaciory result.

Cook. Clin. Journ. London, 1896–97, vol. ix. p. 263. 1 case; Barker's method (cerclage); satisfactory result.

Lejars. Presse Méd., March 30, 1897. 6 cases; open arthrotomy; satisfactory result.

Lucas-Championnière. Journ. de Méd. et de Chir., June 25, 1897. 49 cases; open arthrotomy; satisfactory result in 47; 1 died from chloroform, and 1 from gout and uncontrollable vomiting.

Marsh. St. Barth. Hosp., Brit. Med. Journ., 1898, vol. i. p. 613. 28 cases; satisfactory result.

Riedel. Quoted by Fowler. 1 case; died of chloroform.

Total, 237 cases; satisfactory result, 223, or 94+ per cent.; marked stiffness and disability, 6, or 2+ per cent.; complete ankylosis, 2, or —1 per cent.; died, 6, or 2½ per cent.

SUMMARY.—OPERATIONS FOR RECENT SIMPLE FRACTURE OF PATELLA.

Source.	Total number of cases.	Satisfactory result.	Marked stiffness and disability.	Total ankylosis.	Amputation.	Death.
A. Dennis's[1] table, New York Med. Journ., April 3, 1886.	75	62, or 82+ per ct.	8, or 10+ per ct.	1, or —1 per ct.	1, or —1 per ct.	3, or 4 per ct. (1 from sepsis).
B. Cases personally communicated to the anthor.	474	448, or 94+ per ct.	22, or 4+ per ct.	.....	.....	4, or 0.84 per ct. (3 from sepsis).
C. Cases gathered from literature since the publication of Dennis's table.	237	223, or 94+ per ct.	6, or 2½ per ct.	2, or —1 per ct.	.....	6, or 2½ per ct. (none from sepsis).
D. Classes B. and C. combined.	711	671, or 94+ per ct.	28, or 3+ per ct.	2, or —1 per ct.	.....	10, or 1.4 per ct. (3 from sepsis).

[1] The remainder of the 187 cases collected by Dennis were operations for compound fracture, or fracture of long standing.

As the summary shows, the mortality in the personally communicated cases has been 4 out of 474, or a little less than 1 per cent., while of the cases gathered from literature 6 out of 237 died, or 2½ per cent. If we add the figures we have a total of 711, with 10 fatal cases; three succumbed to sepsis, while the remainder died from other causes.

This mortality of 1.4 per cent., when contrasted with the 4 per cent. of deaths in Dennis's table, shows a definite decrease in the ratio during these later years.

If, now, we analyze these deaths from sepsis we find that both Kocher's and Bontecou's were in the earlier years, while Owens's was in a case of fracture of both patellæ, the patient having sustained added injuries. Certainly, so far as sepsis goes, this record of three deaths and no amputations out of 711 cases seems to indicate that the operation is a safe one; but the question may well be asked whether this represents the true mortality. I must admit that I do not believe that it does. I have trustworthy knowledge of three deaths from sepsis following this operation during the past year, each in the practice of a skilled surgeon, and each in a well-equipped and modern hospital. I am further obliged to add that I am acquainted with one case of amputation for septic arthritis, this following an operation done by a house officer in one of the larger hospitals of our country; but I also know of a considerable number of cases in which the result was in all ways excellent. So that my estimate of the mortality would be that at most it is less than 2 per cent., and that the deaths from sepsis would be rather less than 1 in 100 of all operations.

Of the general results more will be said in detail a little later, but it may not be amiss to call attention at this time to the fact that of the total number of cases but 3 per cent. came out with marked stiffness and disability, and something less than ½ of 1 per cent. with complete ankylosis.

Limitations Attending the Operation. *Selection of Cases.*—As one reads the personal opinions cited in the foregoing pages he is struck by the number who emphasize the fact that only surgeons of, if I may use the term, exceptional judgment and

skill, working amid the most perfectly controlled surroundings, equipped with all that goes to make complete asepsis, and with the aid of carefully trained assistants, should undertake this operation. It is one which entails exceptional responsibility on the operator. It is done for a condition which does not threaten life and in which non-operative methods give fairly satisfactory results. It therefore devolves upon him to select his cases with the utmost care and to surround himself with all possible resources. Patients submitted to this operation should be of a suitable age—let us say, under fifty-five years, and should have healthy viscera. This is imperative. In general one may say that those who are obliged to pursue arduous occupations, occupations which necessitate much standing or walking, may be subjected to operation more readily than those who are not dependent on good knees for a livelihood. Fracture of both patellæ is, I think, a decided indication for operation. Further, the amount of separation between the fragments may guide one in deciding to operate. In general, it may be said that if they can be brought within 1 cm. of each other operation is contra-indicated. In all cases the matter should be submitted to the patient and explained to him as thoroughly as may be.

Time of Operation. Operators differ in this; Fluhrer and others would operate immediately after the receipt of the injury, while Fowler strenuously advises waiting until the acute symptoms have subsided. The latter correctly says that contusion of the tissues about the joint diminishes their vitality, and that in such instance a little sepsis may spread with great rapidity. The same view is taken by Beale[1] who says that operation should be performed immediately after the fracture has occurred only when the two following conditions can be observed together: namely, that blood has not begun to be effused and that no direct violence has been done to the part. There is no doubt that a few septic organisms do occasionally gain access to our wounds, but they are so few that their destroyers are able to cope with them. They will almost certainly overcome them

[1] Treatment, January 27, 1898.

in healthy tissue, but they may not be able to do so in tissue whose vitality is impaired and which is the seat of early inflammatory changes.

Whatever the time adopted for the operation previous sterilization of the operative field should be most thorough, and it must be remembered that in many cases this is very difficult. The knees of laborers, especially those who follow such occupations as carpet laying, scrubbing floors, shoemaking, etc., are apt to be thick and rough and creviced; the cleansing of them should be scrupulously attended to.

Operative procedures. Aside from mechanical aids to close apposition of the fragments, Malgaigne's hooks, the steel rivets of Kittredge, Bruns, and Schumpert, the various methods (Robson, Marshall, Anderson, Miles) of passing pins through the tendon of the quadriceps and the ligamentum patellæ, or the fragments themselves, while endeavoring to open the joint, none of which have met with much favor, we have two principal methods of operation.

The first, which may be termed the procedure of Lister, boldly opens the joint, empties it of clots and sutures the rent in the capsule as well as the fragments of the patella. The other is exemplified by the Barker operation, and is a subcutaneous, or rather percutaneous, cerclage of the bone. This latter procedure is described as follows: After aseptic cleansing a tenotome is thrust into and through the ligamentum patellæ in its mid-line antero-posteriorly, and a small cut made. Through this opening an appropriate needle is carried in and up behind the fragments and made to emerge through the skin just above the upper fragment, the fragments being apposed and steadied. The needle, threaded with stout, aseptic silk, is now withdrawn, leaving the thread behind the bone. It is reintroduced and passed up in front of the fragments and out at the upper hole, threaded and withdrawn below. The fragments are brought well together, friction used to displace clots, etc., the silk ligature tied and the knot buried. White, of Philadelphia, who has employed this method fifteen times, and who speaks well of it, begins passive motion on the tenth day, gets the patient out of

bed, wearing a light plaster splint, at the end of the third week, and says that good use of the joint may be expected in from eight to ten weeks or earlier. We have but few recorded cases of this operation, but these seem to show no casualties. However, it is well to note that White[1] says that while none of his cases have had the least after-trouble, he knows of cases in other hands in which septic arthritis has followed this operation and the patients barely escaped with their lives. White's ultimate results were far better than he had obtained by the older methods, and he urges the adoption of Barker's procedure in all cases.

Of similar plan is the method of Ceci,[2] who employs a percutaneous suture encircling the fragments, that of Butcher[3] which differs but little from Ceci's, Kocher's (since discarded by the Berne surgeon himself), in which the thread was tied over a cushion of rubber or cork in front of the bone, Volkmann who used a form of cerclage, Aitken who drilled the fragments longitudinally and withdrew a thread which he tied subcutaneously.

The peri-patellar percutaneous suture was, I think, extensively used by Stimson, who seems to have given it up in favor of open arthrotomy. I fail to see wherein lies its advantages; it certainly exposes the joint to the risk of infection, it cannot deal with the fibrous tissues which, as we have seen, are almost always interposed between the fragments; it does not reunite the lateral tears, and it does not clear out the joint clots which are so prone to organize and lead to a low grade of arthritis. If any operation be advisable I think that open arthrotomy should be the one selected. Of this there are numerous modifications, but the principle is simply that of free incision, removal of clots and fibrous tissues from the breech, and suture of what needs to be reunited.

It is needless to say that the most painstaking asepsis and the aid of competent assistants are imperative. The incision may

[1] Annals of Surgery, 1895, vol. xxii. p. 661.
[2] Deutsche Zeitsch. f. Chir., 1888.
[3] Brit. Med. Journ., 1892, p. 904.

be the original longitudinal one of Lister, or the transverse cut between the fragments, or a flap turned up from below, as done by Lucas-Championniere, or the U-shaped flap with its attached base below. When the incision is directly in front of the callus a refracture or a rupture of the callus may tear the attached soft parts and so make this second break a compound one, and to avoid this some operators have proposed a vertical incision on the side of the patella; but to this the objection is made that it may be difficult to deal with the torn aponeurosis of the vastus on the opposite side. The vascular supply to the knee is so free that it is hardly probable that a flap turned up or down will slough, and such incision certainly answers all indications admirably. I have said that it is favored by Lucas-Championniere; he is an ardent advocate of operative procedure, and has paid much attention to the details of the operation itself.

Most operators remove all clots from the joint, either by wiping them out with sterile gauze or by gentle salt-irrigation. Antiseptic solutions are uncalled for, a sterile saline solution answers all indications, these being, indeed, simply mechanical. Some writers lay stress on not disturbing the blood, but I fail to see why their advice should be followed. Risk of sepsis is certainly less when the joint is empty, and we have all reason for thinking that the blood organizes and forms adhesions. The prepatellar tissues which have fallen into the breach are to be carefully trimmed away, the fractured surfaces may be cleansed of clots and, if need be, freshened. The lateral tears are to be accurately sutured, preferably with catgut.

As to uniting the bony fragments themselves, a multitude of ways have been set forth. They may be drilled and joined with absorbable or non-absorbable sutures. A single thread may be used, or one on each side.

The holes in the fragments may go through the posterior surface of the bone, or they may stop just in front of it. Some operators of wide experience content themselves with suturing the soft parts at the front of the fragments. If silver-wire be used (and this, from its tensile strength, seems the best of the non-absorbable sutures) it may be tightly twisted and the ends

hammered down in the crevice between the fragments. Silkworm-gut has been used. Heavy, chromicized catgut or kangaroo tendon makes an excellent suture when one is sure of its sterility. Fowler applies hooks devised by him, these to be removed at an appropriate time. Lejars[1] uses cerclage when one of the fragments is very small or when comminution is present. The wire is passed through the tendon of the quadriceps close to the upper fragment and equidistant between its anterior and posterior faces; then it surrounds the fragments, going close to the bone through the ligamentous patellæ below. Berger[2] and others speak well of this cerclage. It is, as Lucas-Championniere says, simply a modification of the operation of arthrotomy and osseous suture. When it is employed the soft parts in front are sutured with catgut.

Comminuted fragments are to be left or removed according to the judgment of the operator. Inability to approximate the fragments is exceedingly rare in these operations for recent fracture, but it may necessitate scoring or division of the quadriceps muscle or its tendon, as has recently been done with marked success by Wyeth and Erdman in cases of long standing, or transplantation of the tubercle of the tibia, as cleverly carried out by Keen.

Employment or absence of drainage will also depend on the individual judgment of the operator. Drainage has two excuses: imperfect hæmostasis and doubtful asepsis. It seems to me that the surgeon whose resources and methods warrant him in undertaking this operation should be able to dispense with it.

The skin sutures and confining splint may be removed on the eighth or tenth day, but at that time it is best to commence massage and passive as well as active motions. I believe early motion to be highly desirable. It prevents adhesions, the massage preserves the quadriceps. At the end of the third week the patient may be up and about; he should wear a check apparatus until the joint has such free flexion that danger of refracture is practically gone. This will be, perhaps, at the end of the

[1] Presse Méd., 1897, p. 125.

[2] Gazette Méd. de Paris, 1897, p. 306.

third month, but he should have resumed active life much before this. It is well for us to remember that almost all of the refractures take place during the first year. We see, then, that this operative management is not purely operative, but, rather, synergistic; a combination of open suture and massage.

Immediate and Remote Results of Operative Management, and Comparison of These Results with Those Attained Without Operation. So far as the immediate results are concerned, there is but little difficulty in arriving at an opinion. We have seen wherein lies the danger to life and to limb, and we learn from the tables, which I lay before you, that at the time of discharge 94 per cent. of 711 operated cases were in a satisfactory condition. I have already referred to the fact that so many reported cases were operative results, but that they did not permit of judgment as to end results. For this reason I placed the table marked "Satisfactory" at the head of the list, rather than one marked "Perfect," for the number which could be accurately grouped under the latter caption would be misleading. So far as immediate results go I question whether operation offers very much of a gain over the Dutch massage method. By either form of treatment the patients resume daily life much earlier than when treated by the older methods. In the personally communicated opinions set forth in the foregoing pages it will readily be seen that the consensus of opinion goes to show that operation saves a goodly amount of time to the patient when compared with confinement measures.

But in the ultimate history of the limb the condition of the callus plays a most important part. A fibrous callus tends to stretch and ultimately to break, and while I have thought it best to discard the term bony union, the history of these cases goes to show that if the union be so complete as to render independent mobility of the fragments impossible, it is improbable that it will become incomplete or permit mobility.

That osseous suture gives by far the greatest percentage of complete union is evident, and, further, I am convinced that it gives the smallest percentage of refractures, a matter of no small importance. This matter of refracture has been carefully

studied by Bégouin and Audérodias[1] who cite thirty cases from Ham,[2] and add five personal cases, each of the thirty-five treated by massage and followed for a sufficient length of time. In 8, or 22 per cent., there was subsequent rupture of the callus. In a complete search of literature these authors find but seven iterative fractures after operation. (Reported by Peyrot, Lucas-Championnière, Mounod, Mayo-Robson, Stimson, and themselves.) While this number is far too small, it is a fact that the closer the union the less is the danger of refracture, and it must be seen that reuniting the vasti relieves a certain amount of the strain brought to bear on the quadriceps tendon.

Stumpff[3] analyzed 28 cases of refracture and found that in 17 the callus gave way, in 7 the bone was fractured anew, in 2 the tendon parted. Crickx found in 31 cases treated by massage, 25 per cent. of refractures, and in 249 cases (from Hamilton, Bull, Le Coin, Howe, Ham), managed by the older confinement methods, 13 per cent. of refractures. He, therefore, concludes that massage gives a greater percentage than any other method, but his conclusions seem to me hasty and based on too few of the massage cases. Surgeons who have performed a considerable number of these patella operations emphasize the rarity of refracture, yet we still need large series of cases followed for a sufficient length of time. Until we get this our conclusions will be merely inferential.

And inferential, as well, must be our conclusions regarding ultimate results. While Halsted, Abbe, and others place all of their results under the head of "perfect" most of the observers have lost sight of their cases at the end of the second or third month. I have, therefore, used the term "satisfactory" as embracing all cases in which the result was better than moderate stiffness and disability. The word "excellent" might be used here, I think, in the sense in which Bull used it. Of the 711 cases definitely reported the result is placed as "satisfactory" in 94 per cent. I should like to get nearer to accuracy in this

[1] Gazette Méd. de Paris, 1897, p. 505.

[2] En Nadeclen van de Behand, etc., Amsterdam, 1893.

[3] Inaug. Dissert. Berlin, 1894.

important matter, but it is impossible to do this until the cases are reported after the lapse of at least a year, while two years would be a better limit.

We are not to overlook the fact that there are practically no arguments against operative procedure on the part of those who have accorded it a fair trial, and this must be taken into consideration in weighing such a matter. Rose, of London, writing in the *Year-Book of Treatment for* 1898, says:

"The open treatment of fractured patella is still looked upon askance by many, but it is gaining ground as the most certain means of securing perfect apposition and union of the fragments." This, I am inclined to think, expresses the matter pretty clearly. Crickx, who has recently made a very careful study of the subject, would employ the osseous suture in all cases in which the diastasis is one centimetre, and in cases in which the capsule is torn laterally (he says that these tears are easy of recognition from the joint distention and bulging), no matter how small the diastasis may be.

My own opinion in this matter is made after a study of the literature and the personal communications which I lay before you, for I have never operated on a recent simple fracture of the patella, and, indeed, began the study of the subject with something of a prejudice against operation.

That the operation has a well-fixed place in surgery seems plain. I believe it should be done only by adepts in surgical art, that it should be confined to healthy individuals of suitable age, that its dangers and advantages should always be fully explained to the patient, that it should be reserved for fractures presenting a diastasis of over one-half of an inch or with extensive lateral tears of the capsule, and that it should always be supplemented by early massage and mobilization of the joint. The preferable form of operation is open arthrotomy. The suture of the soft parts should always be carefully made, such suture may be applied to the bone as the operator's judgment may dictate. Such cases as are not suitable for operation may best be managed by the Dutch massage method, and this form of treatment may well be adopted by the general practitioner who thinks it inadvisable to undertake operative measures.

DISCUSSION.

Dr. Joseph D. Bryant, of New York.

In 1880 the late Professor Frank H. Hamilton published what he was pleased to denominate "A Study of 127 Cases of Fracture of the Patella." In the opening clause of this excellent and comprehensive review we find the following expression: "No one, so far as I know, has attempted to record and carefully study any large number of cases of fracture of the patella." It follows, therefore, that the conclusions drawn from this aggregation of cases by one so eminent and painstaking as was Professor Hamilton, become at once of unusual significance in estimating the value and scope of newer methods of action directed to their treatment.

In computing the comparative worth of the different methods, your attention is respectfully called to the importance in this regard of the following determining factors: 1, the degree of physical infliction; 2, the duration of confinement in bed as bearing respectively on the comfort, the health and the business demands of the patient; 3, the character and importance of the inherent and acquired complications of respective methods of action; 4, the final burdens imposed by the sequels of different plans of cure.

1. A state of *physical infliction* is sometimes a comparative condition, since that which is burdensome to one, may scarcely annoy another. The method of practice that provokes the least physical suffering and personal danger compatible with the procurement of a serviceable limb, is to be commended. Under this heading one can hardly classify many of the apparatus directed to the control of muscular contraction with pressure-apposition of the fragments that are figured in the books. I shall not invidiously designate them by name, as they are of the best of their time.

The inclined plane method devised and practised by Hamilton, though available and efficient, is tedious, often painful, and always confining. The plaster-of-Paris plan—while not especially painful and confining—seems to me, instead of establishing its own potency in the attainment, illustrates how little is needed to secure the result. The hooks of Malgaigne and the offspring of the idea are not encouraged by the profession nor welcomed by the patient. Their proper use complicates personal comfort with aseptic care and confinement

in bed, and introduces a new element of surgical responsibility and personal infliction, without the prospect of a commensurate reward. A method of mechanical treatment, of which I shall speak later, and suturing, are, according to my experience, attended with less physical discomfort than are the other methods of practice.

2. *The duration of confinement* in bed, etc., under the older plans of action, is aptly stated by Hamilton in connection with his method of treatment. He says: "At the end of four weeks the apparatus should be removed carefully . . . the splint reapplied . . . as before." "Thereafter the splint is removed daily. In the meantime the patient may go about upon crutches, if he chooses." It will be seen that by the means of this once admirable method of practice the patient lies on the back in bed for four weeks with the limb immovably fixed to the splint. Much discomfort is thus incurred, not only to the limb but at-large to the patient. The influence of a period of confinement on the health and business affairs of a patient are matters of importance, but not of sufficient moment, as a rule, to lighten the burden of proper treatment. A plan of practice that will abolish the need of recumbent posture, and at the same time permit the patient to attend to his more important affairs on crutches, and with comparative comfort and security, should be welcomed as a practical advance in the treatment of fracture of the patella.

3. *The character and importance of the inherent and acquired complication of the respective methods of treatment* are matters of special significance. The *inherent* complications are a part of the history of the injury and are independent of the means of treatment. Acute synovitis and pre-patellar bursitis are the leading ones, and, according to Hamilton, happen in nearly 23 per cent. of the cases. And further, in this connection, speaking of synovitis, Hamilton says: "Usually this is moderate, but it has ocasionally, and especially when injudicious pressure has been employed, resulted in suppuration of the areolar tissue." It is respectfully submitted that these facts suggest at once the inadvisability of active interference until after the abatement of the transient effects of violence. The acquired complications present a different aspect, and principally because they are the result of the surgeon's effort directed to the repair of the defect. The personal comfort and usefulness of the patient are often measured by the wisdom displayed by the surgeon in his endeavor to supplement the efforts of nature. The annoyance, pain, abrasion, and blistering that may attend

mechanical expedients are of temporary nature, easily remedied and usually less dangerous to the limb of the patient than to the reputation of the surgeon. The picture is different, however, when operative expedients supplant the mechanical ones. Then, and properly too, the danger to the limb is the gauge of the discretion of the surgeon and an earnest of the professional blight that may follow the patient's discomfiture. The acquired complications begotten of operative procedure are too often of weighty import, involving the integrity of the limb and even the security of life itself. And thus it follows that operative practice of questionable prudence for other than established necessity is laden often with physical and professional disaster. The final burdens imposed by the different plans of cure encroach in some cases upon the complications, especially when the loss of life or limb, or the presence of an ankylosed joint arise, as they only do from an acquired complication of operative practice.

The practical elimination of the confinement and annoyance arising from the treatment of simple fractures of the patella by naturally safe mechanical means alone, brings us face to face again with the necessity of estimating the worth of the outcome of this method as compared with that of the inherently dangerous one. Please understand, I use the expressions "naturally safe" and "inherently dangerous" in the general sense of their relation to the efforts of the custodians of the majority of these fractures, the profession at large, rather than to the limited few whose knowledge of scientific technique does not enable them to treat the smaller number without occasional disaster. The question is not what can be done by the few, but what should be done by the many.

Your attention is called again to the statements of Hamilton regarding the kind of union that follows treatment by mechanical means and of his opinion regarding the deformity and capacity for use. An examination of the results, as compiled by Hamilton, shows that 22 per cent. of the cases recovered with a ligamentous union a quarter of an inch in length, 45 per cent. and 17 per cent. with similar union of half and three-quarters of an inch respectively. The twelve remaining cases had ligamentous union from one to five inches in length. Hamilton reports that in twenty-seven cases the ligament "gave way more or less completely" during the seventh and eighth weeks from slipping with the first efforts in walking. This is indeed an important exhibit bearing on the utility of the methods of practice which this

outcome represents, and not unlikely, too, on the lack of caution exercised in the after-treatment.

At all events, after this further summing up, Hamilton says: "I think, in the light of this experience, it may be said that after the fifth month there is no more danger to the injured limb than to the sound one." Further on he remarks, "Our investigations have brought us to conclude that in a large majority of cases, under any plan of treatment, a fibrous union of the fragments is all that can be expected; and that probably a fibrous union with separation of half or three-quarters of an inch is as useful as a bony union." Whatever may be the present opinion regarding these conclusions, they have the merit of emanating from an experienced, honest, and judicial source, uninfluenced by the more recent contention regarding operative procedure.

I am not inclined to the practice of suture of the patella except in instances emphasized by special indication for the step. The fact alone that a patella is fractured does not suggest to me the need of suturing unless the fracture be a compound or ununited one, one with a ruptured ligamentous union, or with the opposite knee already insecure from a previous injury or disease, etc. The intolerance of confinement in bed in simple cases, or the unwisdom of this practice for any reason, I once regarded as sufficient to justify suture of the bone. But now, since by mechanical means alone confinement in bed can be obviated, and the patient permitted to be about on crutches with safety, sooner than when suturing is practised, I am disposed to regard suturing unfavorably in such cases.

I regard suturing of the patella as a justifiable measure in selected cases. But would not perform it except for other reasons than that of the existence of a simple fracture, because I do not believe that it is good surgery to expose a patient to the contingencies of grave complications for the better rectification of an injury which at its worst has no tendency to terminate fatally, and almost invariably results in a serviceable limb when treated by ordinary methods.

I have wired the patella nineteen times for simple fracture. A compound one has not yet come under my personal care. Of these cases each made a satisfactory and uneventful recovery, with a useful limb, except three. One died of delirium tremens on the third day after the operation; this cannot be charged to the account of wiring. In another the joint became infected, and was treated with successful issue by free incision and continued flooding of the joint-cavity with

a warm, weak solution of bichlorate of mercury (1 : 10,000). The third, a patient in private practice, had extensive suppuration of the

FIG. 1. FIG. 2.

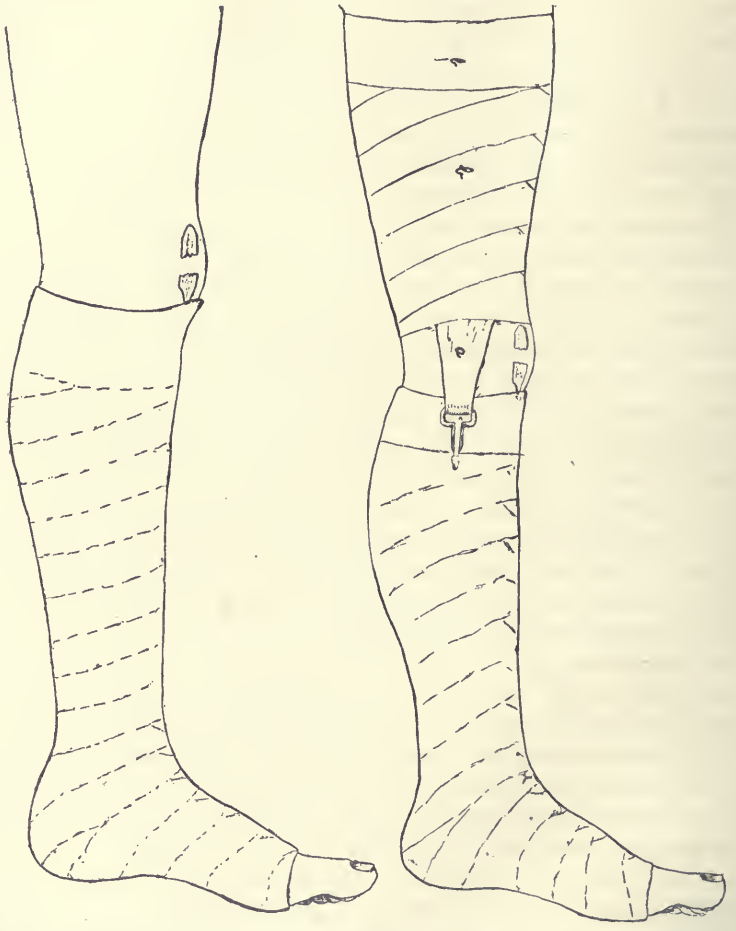

FIG. 1.—Represents the leg and foot of the injured limb encased in a plaster-of-Paris splint, extending up to and confining the lower fragment. This control can be supplemented later, if need be, by properly applied compresses introduced beneath the border of the splint.

FIG. 2.—*a* represents extension straps applied to each side of the thigh and confined in place with an ordinary bandage, *b*, *b*. At the ends of the plaster extension (*a*) are noticed snaps to catch the rings of the web extension, Fig. 6, *x*.

FIG. 3.

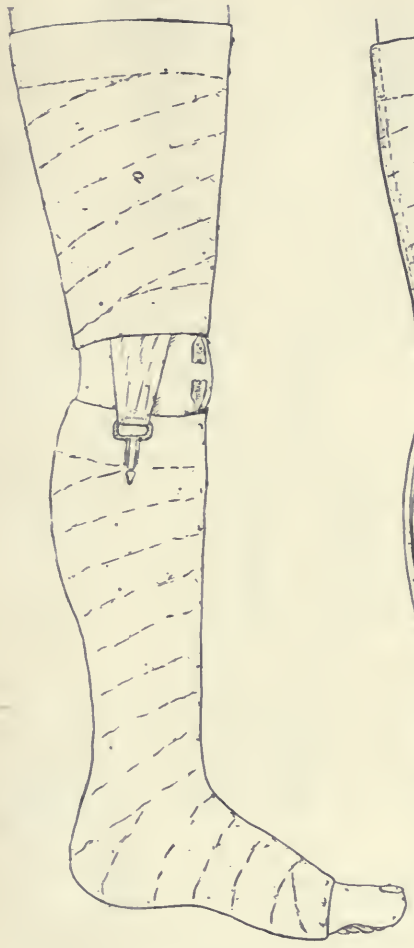

FIG. 4.

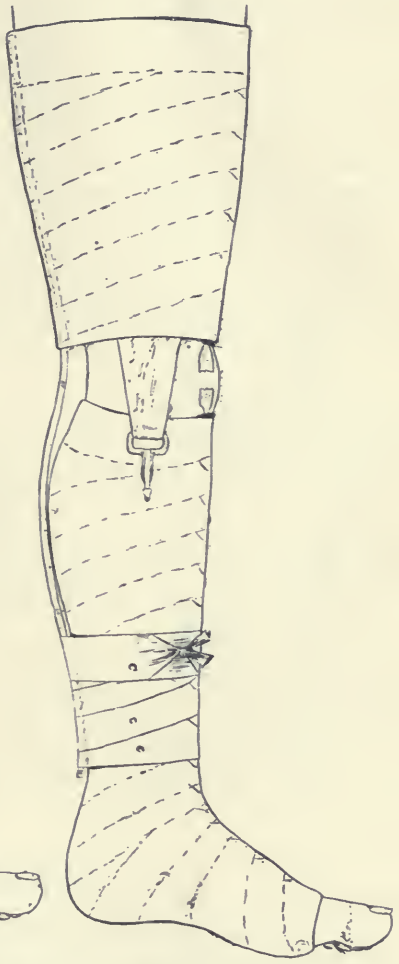

FIG. 3.—Represents the thigh and leg encased in a plaster-of-Paris bandage, the former (*a*) corresponding in extent to the adhesive plaster extension (*a*, Fig. 2), and going down to and supporting the upper fragment. This bandage, *a*, affords fixation to the upper end of the posterior iron support (*B*, Fig. 5), to which it is confined in place by additional layers of plaster bandage.

FIG. 4.—Represents the posterior iron support in place (*B*, *B*), imbedded above in the plaster splint, and properly retained below by an ordinary roller passed two or three times around the limb and tied in front, *c*, *c*, *c*.

FIG. 5. FIG. 6.

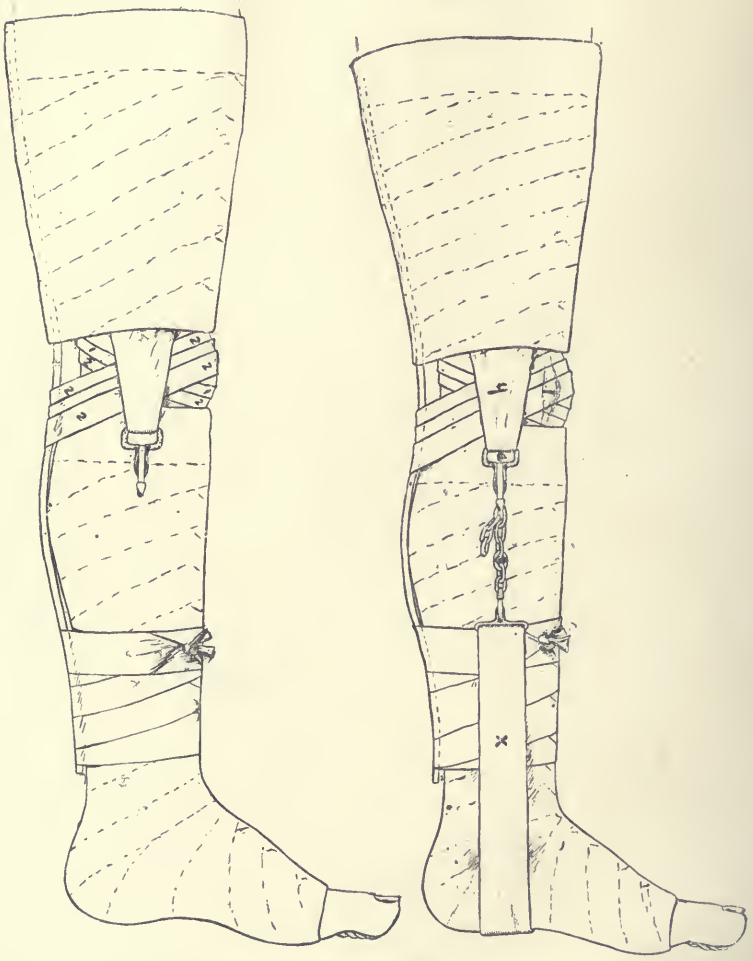

FIG. 5.—Represents in addition to the preceding: 1, the coaptation strips of adhesive plaster applied to the *lower fragment* and attached to the posterior surface of the leg and thigh (1, 2, 1, 2); 2, similar strips (2, 2, 2, 2), extending between the upper fragment and the posterior iron support (*B*), so that the downward movement of the support, due to the elastic extension (Fig. 6, *x*), will maintain the upper and more important adhesive strips firmly in place.

FIG. 6.—Represents the elastic webbing extension in position (*x*), drawing down and holding the fragments in place. The degree of force exercised by it can be regulated by varying the attachment of the chains (*B*) at the ends of the elastic extension *x* with the hooks (*a*) at the extremities of the adhesive plaster (*y*).

connective tissue about the joint, but with no certain evidences of interarticular involvement. At the present time the joint is quite stiff, owing mainly, in my judgment, to the persistent opposition of the patient to the infliction of passive motion.

The technique of operation practised by me at the present time consists: 1. In making a short vertical incision. 2. Removing the blood-clots from the fractured borders of the bone, along with the interposed fibrous tissue that is sometimes present, and cleansing the joint cavity. 3. Draining the joint with a few strands of silkworm-gut at the outer side. 4. Uniting the fracture with a small wire so placed as to cause retention, proper apposition of the fragments. 5. Closure of the wound, antiseptic dressing and fixation in bed for two weeks, followed by plaster-of-Paris bandages, and out of bed on crutches.

The rupture at the sides of the capsule is not mended by sewing, for it is not regarded essential to a satisfactory outcome, as is witnessed by the results in this regard of cases treated by mechanical means alone and other plans of suturing.

The mechanical method of treatment to which I desire to direct your attention has been employed wholly or in part by myself in the treatment of fifteen cases of simple fracture during the last twenty years.

I claim for it: 1. That it is comfortable and efficient. 2. That it is not attended with danger, nor is confinement in bed for a longer period than a week necessary. 3. That the results are equal to the best of those of other mechanical means of treatment. The preceding illustrations will explain the manner of application even better than words can.

DR. MAURICE H. RICHARDSON, of Boston.

There are points in this paper which affect every practitioner. Recently one of the most successful general practitioners in my community was criticised because he did not wire the patella, and in this particular case the criticism was unjust.

The first remark that I wish to make is to be considered in reference to those cases which are to be treated by good surroundings in patients in good health by a surgeon of experience in the technique of the operation and in the technique of asepsis. If we are to consider the treatment of the patella in general among those whose experience is limited, I think we must take the position that a fracture should not

be wired under any circumstances. I am sorry that the author had to omit reading some of his paper, and particularly that part in reference to the anatomical and pathological conditions, for I think the question of separation of the fragments is most important.

You are all doubtless familiar with the fact that if the patella alone is divided there is little if any loss of power of extension. I have showed this in my demonstrations on applied anatomy, by extending the foot with the subject lying on his back and with the leg over the table, and then employing traction on the quadriceps. Complete section of the quadriceps will be shown by a sinking of the patella. If we can get complete control of extension in cases in which the fracture is limited to the patella there is no need of opening the joint, but if we have so extensive a laceration that we have no control of extension, then it seems to me that the advisability of wiring is to be seriously considered. The time of confinement in ordinary cases of fracture of the patella should be six months. It has been shown that in the ordinary non-operative methods of the treatment of fracture of the patella that they recur if the patient walks within six months. I should say that we are not to be influenced by the bad results which follow the too early use of the limb. The results in non-operative cases with extensive separation are extremely good. I have seen a sea captain who had extensive comminution of the patella and who can walk now perfectly well, although the accident occurred three months before he got into port. It is not necessary to repeat the good results which have followed bad cases, for we all have seen them. The question is whether we can predict a bad result.

As to the separation of the fragments, at the Massachusetts Hospital, between 1888 and 1898, the records show that there were 128 cases of fracture of the patella treated there, of which 113 were simple fractures. Of this 113, 15 were wired, and of the wired cases two suppurated. I think one of the wired cases was my own, as I know in one of them there was a wide separation. This means to say that in fifteen case of simple fracture infection only occurred in two. I am convinced on my own experience that no wounds can be assuredly aseptic, for I believe that all cases are infected, and especially wounds that are opened for any length of time. The so-called aseptic healing is because the infection is not successful, and in my experience a wound of the knee-joint is especially liable to infection, so that it is hard to prevent serious results. I consider, therefore, that this opera-

tion of opening the joint is a very serious one, and may be followed by the loss of the patient and death. I have opened the joint for foreign bodies, but have never felt that security that I should feel in an amputation or a removal of the breast. Perhaps the knee-joint is not infected any more than any other part of the body, but it is less able to withstand the attacks of micro-organisms, and we must, therefore, consider interference with more deliberation.

The best time to wire the patella is when we have demonstrated the failure of conservative methods, and we should watch for the absorption of effused blood. It seems clear that effused blood is the best field for infection, and, as has been shown by Halsted, the most successful aseptic operations are those which are bloodless. We should wait a certain length of time to know just how bad the result is to be before going into the joint.

Dr. James E. Moore, of Minneapolis.

I believe this paper represents the opinion of American surgeons to day—that is, of those who are conservative; and by conservatism I do not mean that we shall refrain from operations. I think that Dr. Powers' personally collected opinions are a very good index in a certain way, and they come from surgeons who have ample hospital facilities at their command. They report favorably on the operation, but they do not advocate it as a universal practice, and very few say that they always perform open arthrotomy. The argument, therefore, is in favor of a good surgeon, with proper surroundings. The mortality-rate in these selected cases is less than 1 per cent., and this is as small a mortality-rate as we can get from any operation. There is only 3 per cent. of unsatisfactory results, which is infinitely better than the very best results reported by treating fracture of the patella by non-operative means. It is of interest to notice that in these reported cases operations have increased in number within the past few years, and that the increase is in the hands of men who have done the most work in this line. Men who have operated upon these cases under favorable circumstances have been well pleased with the results, and it would be of interest to know why those who are opposed to operative procedure are opposed to it. I know of one eminent surgeon who takes the stand that he is opposed to operative interference under any circumstances, and I happen to know that his experience is one case in which the man died of septic arthritis. This is an unfair conclusion.

I agree with the author of this paper, and with most of those who have written and spoken upon this subject, that this operation of open arthrotomy is more dangerous than a simple laparotomy, as the lymphatic system of the knee cannot be compared with that of the peritoneum. The peritoneum is able to take care of infections, while the knee-joint cannot do so, and Dr. Powers' conclusions, therefore, are justifiable—*i. e.*, that open arthrotomy, with the proper environment, is proper. I do not believe, however, that this should be accepted as a general practice, else every tyro will be making open arthrotomies, and the graveyards will be filled with men who have had simple fractures of the patella. A man in general practice who is not sure of his asepsis has no right to open the knee-joint; but if we do operate upon the knee-joint open arthrotomy is the only thing to be considered, as any other method savors of homœopathic surgery. Dr. Powers' results show that there is less than 1 per cent. of mortality, which is practically no mortality, and there is no operation which will give better results. I am sure that passing ligatures around the patella will be just as fatal, if not more so.

Dr. Powers does not commit himself as to the time when the operation should be performed, but Dr. Richardson touches upon this point. I must differ from him, as I do not see why we should defer operation, as we can be just as successful by operating immediately. We all know that the trouble in late operations often is to approximate the fragments, and we are obliged to cut right and left in order to do this. We have to stir things up just about as badly as they were stirred at the time of fracture, and I do not see, therefore, what we gain by waiting, so that I advocate immediate operation.

There is one point in the matter of techniqne. I do not advocate the drainage of wounds in general. I am in favor of the principle that when we are in doubt as to whether or not we should drain, do not. In open arthrotomy I think we should drain, because, if we open a large joint there will be an excessive amount of discharge, which will cause a mechanical distention and interference with circulation. I think, therefore, that we would get the best results by temporary drainage. I have had some experience in making a cutting operation for congenital dislocation of the hip, and have been driven to drainage sometimes in those cases.

One point of considerable interest is that which refers to recurrence after operative procedures, and on this matter we have very little to

go upon at the present time, but it is a good point upon which to make notes in the future. Should patients who have been subjected to an open arthrotomy expect a recurrence? I believe not.

One point made by Dr. Richardson is interesting, and that is that the amount of separation is an index as to what should be done. I think there is a chance for discussion on this point. All of us who have treated these cases know that the amount of separation is not a sure index of the amount of usefulness of the limb. In one of my best cases there is a separation of four inches, and yet he walks very much better than patients with only two inches of separation.

Dr. W. S. Halsted, of Baltimore.

I cannot indorse Dr. Moore's views as to drainage of the knee-joint after suture of the fractured patella. We rarely put drains of any kind into the knee-joint, even though it be infected. A drain can relieve tension, but it cannot dispose of all the organisms of an infected joint; the tissues have to take care of these in a large measure, and they can often do this better without a drain than with it. A drain produces invariably some necrosis of the tissues with which it comes in contact, and enfeebles the power of resistance of these tissues toward organisms. But given necrotic tissues plus infection, and a drain becomes almost indispensable. In abdominal cases, for example (I am now speaking of the principles of drainage in general), it is not sufficient to drop a drainage-tube or a piece of gauze down into the middle of a necrotic area; the entire necrotic area should be circumscribed by gauze-packing and excluded in this way from the rest of the peritoneal cavity. No drainage at all is better than the ignorant employment of it.

Dr. Powers. As to drainage, I spoke of this at some length in my paper. I believe in the body of the article it is stated that if a surgeon feels competent to undertake this operation he should feel safe in dispensing with drainage.

THE USE OF ANIMAL TOXINS IN THE TREATMENT OF INOPERABLE MALIGNANT TUMORS.

By GEORGE RYERSON FOWLER, M.D.,
NEW YORK.

The Cure of Malignant Disease by Accidental Erysipelas. Early in the seventeenth century, according to Fehleisen, it was known that not only malignant growths, but certain chronic ulcers, lupus and syphilitic destructive lesions, were arrested, and in some instances absolutely disappeared following an invasion of erysipelas. In modern times Billroth called attention anew to the subject, by reporting a case of inoperable sarcoma of the pharynx cured by an attack of facial erysipelas.

There has been some dispute as to the authenticity of such cases, but it must be admitted that while it is very difficult to verify at this late day the assertion that all the cases denominated true sarcoma were in reality examples of that disease, yet it is going too far to say that all of the accounts bearing upon the question are absolutely untrustworthy. Nor will it suffice to declare the occurrence of the erysipelas and the disappearance of the growths as merely coincidental. The theory of spontaneous disappearance of the growths as a coincidence in the course of or following an attack of erysipelas falls at once to the ground in the face of the fact that the spontaneous disappearance of growths which, even with the limited knowledge of pathology at the command of our predecessors, could have been mistaken for malignant disease, is absolutely unknown. Moullin,[1] in investigating this subject in a most conservative,

[1] The Lancet, February 5, 1898.

painstaking, and impartial manner, was able to identify fifteen undoubted instances of sarcoma in which an attack of erysipelas occurred. Of these, in no less than nine all evidences of the growth disappeared, and in some instances no recurrence had taken place for seven years. As corroborative evidence of the influence of the erysipelas it may be said that, of the remaining six cases, five showed a decided lessening in the size of the growth.

The cases reported by Billroth,[1] Busch,[2] Bierdet,[3] Plenno,[4] Bruns,[5] Coley,[6] Winslow,[7] Stein,[8] Klieblatt,[9] Fehleisen,[10] and Wyeth,[11] in all of which the growths were either markedly diminished in size, softened, or disappeared altogether, under the influence of the infection of erysipelas, should leave no doubt in the mind of any reasonable person that malignant disease is influenced in a remarkable manner by the presence of this disease.

Répin[12] collected twenty-one observations of modified or cured tumors by accidentally acquired erysipelas. Among these 11 were one or another of the varieties of sarcoma, viz., 6 round-celled sarcomas; 3 lymph-sarcomas, and 2 melanotic sarcomas. Of this number 6 were permanently cured. In 11 other cases of malignant tumors the amelioration was only temporary. In 5 of these epithelioma was the disease; in 6 apparent sarcoma of diverse histological variety. A study of these reveals the fact that the effect of an erysipelas in the neighborhood of a tumor is to produce in the latter signs of necrosis; softening occurs in subcutaneous tumors, followed by a sinking

[1] Senn: The Journal of the American Medical Association, July, 1895, p. 131.
[2] Berliner klinische Wochenschrift, 1866, No. 23.
[3] Deutsche med. Zeitung, 1895, No. 4.
[4] Archiv f. klin. Chirurg., 1886, Bd. xxxiv, p. 688.
[5] Beiträge zur klin. Chirurg.
[6] The American Journal of the Medical Sciences, 1893, p. 487.
[7] London Medical Recorder, 1884.
[8] Vratsch: St. Petersburg, 1882, No. 16.
[9] Munchener med. Wochenschrift, 1890, No. 7.
[10] Des Erysipel., Berlin, 1888.
[11] Journal of the American Medical Association, 1894, p. 985.
[12] Répin: Revue de Chirurgie, 1895, p. 466.

away from the surface and atrophy. Pre-existing ulcerative conditions of the tumor are followed by sloughing away of portions of the growth in fragments. Some, particularly glandular growths, suppurate. In all of the eleven cases the destruction of the neoplasm was but partial and the arrest only temporary. The growth soon resumed its encroaching and progressive invasion of the surrounding tissues.

The remarkable effects of erysipelas upon malignant growths, including changes involving necrosis, atrophy, and even radical cure, have been observed even in cases in which the erysipelas has been located at a point distant from the site of the tumor.

The good effects of accidental erysipelas in this class of cases has for some time suggested the idea of bringing about the disease as a therapeutic resource. Ricord attempted to elevate it to a method in the cure of obstinate syphilides, but the use of the remedy was too dangerous to be justified in the cure of disease amenable to other treatment.

When the isolation of the microbe of erysipelas was discovered by Fehleisen, the latter sought to provoke erysipelas at will in patients the subjects of inoperable malignant tumors. It was soon shown that inoculations of pure cultures of the streptococcus erysipelatis gave results quite comparable to those following accidental erysipelas.

Fehleisen[1] succeeded five times in producing erysipelas in subjects of malignant tumor. He obtained a cure in a case of carcinoma of the breast, and in four other cases (two sarcomas and two carcinomas) there was a partial necrosis, or a temporary atrophy of the tumors. The same result was obtained in a similar case in the hands of Holst.[2]

Coley[3] succeeded in producing typical erysipelas only three times out of ten trials. One of his cases was that of a man, aged forty years, with sarcoma of the lower lumbar region and groin. The groin tumor was removed by operation, but recurred in four weeks. He was then inoculated with erysipelas, as a

[1] Op. cit. [2] Annales de l'Institute Pasteur, 1888, p. 243.
[3] The American Journal of the Medical Sciences, May, 1893.

result of which both the tumors disappeared. Three months later, however, recurrence took place, which was followed by a second inoculation, and again the tumors disappeared. Another recurrence took place. Inoculation was again attempted, and a very decided reaction followed, but erysipelas failed to appear, although the tumors decreased in size. A week later, however, a spontaneous attack of erysipelas occurred in the same region as the last, and during the three weeks following two similar attacks occurred, though milder in type.[1]

The first of these was a striking case of sarcoma of the tonsil and secondary involvement of the structures in the neck. The latter had been operated upon three times prior to this. Fehleisen's method of inoculation by scarification was attempted, but proved unsatisfactory, and one-half to two grammes of bouillon cultures were injected into the neck tumor, with the result that although no attack of erysipelas occurred, and but slight reaction followed the injections, improvement followed. This, however, ceased, and the tumors began to increase in size when the treatment was discontinued. A new and more virulent culture was obtained, and a severe attack of erysipelas followed its injection. This was followed by disappearance of the tumor in the neck.[2]

The particularly striking feature of these observations is the constancy of the effects produced both by Fehleisen and Coley. Whenever a decided erysipelas was produced an effect upon the tumor was observed.

In future studies of the subject it may be possible, following Neelsen, to obtain histological examinations of the growths when undergoing destructive metamorphosis.

The Use of the Septic Products of the Streptococcus Erysipelatis. The method of direct inoculation by scarifica-

[1] This case was finally treated and a permanent result obtained by the employment of the toxic products of erysipelas and bacillus prodigiosus. The American Journal of the Medical Sciences, September, 1896, p. 258.

[2] This patient was examined in September, 1895, within a month of four years following the last inoculation, and nothing was to be seen upon the neck save the scars resulting from the former operations. The tumor of the tonsil was still present, although it had shrunken in size and lost its malignant features.

tion of Fehleisen, and the injection of bouillon cultures of Coley, found very few followers, this doubtless being due to the only partial successes as well as the dread of provoking a mortal disease. The fatal cases of Janike,[1] Neelsen,[2] and Coley[3] emphasize this. These facts, added to which was the difficulty of preserving the virulency of the streptococcus, contributed to cast discredit upon the method.

Following Brieger and Frankel's discovery, Lasser,[4] of Berlin, in 1891, employed the toxic products of the germs alone. The method of filtration was employed to separate the germs from the toxins, after which the latter were sterilized by steam. After several injections practised on himself, and also upon animals, by his assistant Friedlander, the innocuity of the material was demonstrated when it was injected into the nodules of an epithelioma of the face which had followed lupus. Doses of 25 c.c. of the culture were employed. Toleration of the injection was reached before any favorable influence upon the growth was obtained, and the attempt was abandoned. The effect upon the neoplasm, save a trifling irritation, was absolutely *nil.* Lassar was followed by Spronck,[5] of Utrecht, Holland, who likewise believed that sterilized cultures would attain the same end as living and virulent micro-organisms. Uncertain as to the best methods of accomplishing this end, and believing that cultures sterilized by filtration and those sterilized by heat united different properties, he employed a mixture of the two liquids. For media culture he employed the bouillon of meat, bouillons of peptonized beef, white of egg, and serum of beef. His experiments were carried on with cultures of different ages made at varying temperatures and either in the presence of air, or partially or entirely in oxygen. Five per cent. of glycerin was added to the bouillon cultures and the fluid evaporated to one-tenth of its volume. Those sterilized by heat were heated to

[1] Centralblatt f. Chirurgie, 1884, p. 55. [2] Loc. cit, No. 44.

[3] The American Journal of the Medical Sciences, May, 1893, p. 506.

[4] Deutsche med. Wochenschrift, 1891, No. 29.

[5] Tumeurs malignes et maladies infectieuses, Annales de l'Institute Pasteur, 1892, p. 883.

100° C., and those sterilized by filtration were filtered through porcelain.

Spronck carried on experiments upon animals as follows: The filtered liquid was injected into the veins of rabbits in doses of from 10 to 15 c.c. per kilometre of the weight of the animal. Death occurred in from twenty-four to forty-eight hours. Varying effects were observed according to the virulence of the streptococcus which furnished the cultures, as well as the degree of susceptibility of the animal.

Dogs affected with tumors were treated by this method. In the case of a dog affected with a tumor the subcutaneous injection of the liquid in larger proportionate doses produced no untoward symptoms. Some redness and transient swelling took place at the point of injection, but no suppuration nor necrosis occurred. The subcutaneous injection of several c.c. produced a slight and irregular elevation of temperature. Gradually increased doses, administered with several days between, did not produce general symptoms of poisoning.

In the case of two of the animals, repeated subcutaneous injections practised at a distance had no effect upon the tumors, as shown by an examination of the latter after removal. The tumor in one of these experiments was an epithelioma in the anal region. The other was a lipoma of the mamma.

In five other dogs the changes in the tumors were more marked. Following injections practised at a distance and in increasingly large doses the tumors took on a livid violet color, with increased heat; in two cases the growths became painful upon palpation. The injections being continued, softening and necrosis of the neoplasm began. In two cases these alterations occurred with astonishing rapidity.

Ablation of the remaining portions of the growths was then practised. Microscopic examination of these showed that the tumors had undergone localized alterations only. The histological varieties embraced two sarcomas and three epitheliomas. In isolated points fatty degeneration with islets of necrosis and infiltration of the polynuclear white blood-corpuscles was found. Cells the seat of indirect division were rare. These alterations

did not differ materially from those frequently found in malignant growths.

One of the most interesting and conclusive of Spronck's observation is the following:

A large but cachectic cart-dog presented a tumor of hard consistence, and the size of a child's head, upon the right shoulder, which constituted a local recurrence of a small tumor that had been removed by operation a year previously. The exact nature of the primary growth had not been determined. Upon the fourth day of treatment a slight swelling of the tumor was noticed, together with some discoloration, and increased heat and tenderness as well. The growth softened and presented isolated fluctuating areas, with well-defined outlines. This softening process went on until at the end of three days the entire tumor was converted into a liquid mass covered by the intact skin. Incision gave exit to a puriform fluid containing the débris of the broken-down tumor and a large number of leucocytes. The animal died, and the post-mortem examination revealed only a small fragment of the tumor attached to the skin remaining. The microscopical examination of this showed the growth to be adeno-sarcoma.

The clinical symptoms presented by the animals as a result of the presence of the erysipelas, as detailed by Spronck, and their resemblance to those present in man as a result of the injections, are of the most indubitable character.

Twenty-five subjects with inoperable malignant tumors were treated by Spronck up to the time of his report. Unlike Lassar, he employed the injections at a distance from the tumors. Of these 8 were cases of sarcoma, among which were 2 of melano-sarcoma. The remaining 17 cases were carcinomas, viz., 6 of the breast, 1 of the parotid gland, 7 of the tongue or buccal cavity, and 3 of the skin. The injections were made in the subcutaneous cellular tissue, and by preference in the lumbar region. The culture fluid, from one to two-tenths of a cubic centimetre, was diluted with normal salt solution. The dosage was increased more or less rapidly, according to the reaction; in some instances a dose of several grammes was reached.

Following the injections, first elevation of temperature, and

then other phenomena took place, these varying with the dosage. Lancinating pains took place, particularly in primary growths, but were also observed in large secondary tumors of regional recurrences, as well as in some metastatic growths. On the other hand, in small secondary growths patients did not feel the slightest sensation. In several cases these pains made themselves felt two or three hours following the injections, and disappeared on the following day. Increased sensitiveness of the growth was noted during this time. In three cases there was slight tumefaction, with heat and redness. These symptoms were more noticeably marked in the sarcomas than in the carcinomas. The most marked reaction was observed in a patient the subject of a number of metastatic tumors which developed following the extirpation of a small primary alveolar sarcoma of the skin. The injections, although carried on in small doses, were followed by swellings and softenings so intense that under the influence of a fear excited by the first statements concerning the dangers of the use of Koch's tuberculin, the treatment was abandoned.

As to the final therapeutic results: In a majority of cases the growths were not modified. In others they seemed to yield somewhat, while in a small proportion of cases a complete arrest took place; in a small number of the latter some diminution in the volume of the tumors was noticed. In cases of multiple tumors all of the latter were not influenced to the same extent, although some disappeared completely. In no case was a patient entirely relieved of all his tumors, and in instances where amelioration was marked this proved to be only temporary; the neoplasms began to grow again in spite of a continuation of the treatment, a seeming toleration of the toxins being established.

Among the carcinomas only one, that of the breast with involvement of the axillary glands, was markedly influenced by the treatment. The glandular involvement disappeared almost completely, only to reappear.

Examination of tumors extirpated after a series of injections was made in five cases. In one case, that of a melano-sarcoma,

comparisons were made between tumors extirpated before commencing the treatment and their removal after a number of injections. The latter presented marked changes, these consisting of a flabby, wrinkled appearance, and a decided tendency to greater contraction when placed in alcohol. They were likewise less rich in small cells and in mitoses than the first. In some localities the characteristic cells of sarcoma had disappeared, nothing but the connective-tissue framework of the tumor remaining, this containing pigmentary granulations and some leucocytes.

Spronck came to the conclusion, as a result of his experience, that the therapeutic action is not sufficiently demonstrated. It was shown, however, that the toxic products of streptococcus erysipelatis when absorbed from the subcutaneous connective tissue, both in man and in animals, lead to alterations tending to necrosis and to the absorption of the neoplasms.

Prior to this Coley had observed that even in cases in which erysipelas was not produced by attempts at inoculation, notable improvement in the growth followed the injections of bouillon cultures. This naturally suggested that the curative action might be due in whole or in part to the influence of the toxins rather than to the germ itself. If this should prove to be true, a great advance would have been made, since the treatment would be robbed of many of its dangers, and the dosage better regulated by substituting the toxins for the infecting agent itself. The advantages of a methodical treatment over a haphazard and dangerous experimental inoculation of a not infrequently uncontrollable disease were at once appreciated. The effects of the toxins would be under control to some extent, at least, as compared to the disastrous and untoward results of turning loose upon the patient the virulent streptococcus erysipelatis, with all its local and metastatic possibilities, to say nothing of the dyscrasial effects from toxins, the production and dissemination of which would be in proportion to the extent of a too often uncontrollable local environment.

Like Lassar and Spronck, Coley was doomed to disappointment. Attempts to obtain results after sterilization of the

bouillon cultures by steam heat to 100° C., produced toxins too feeble in their effects for use, and filtration through the Kitasato filter still further lessened their efficiency.

Répin's[1] experiments were carried on in the service of Périer, in Paris. Cultures were obtained from two different sources, the one from a fatal case of erysipelas, 1 c.c. of the culture of which injected subcutaneously into a rabbit proved fatal. The other specimen was obtained through Marmorek from Metchnikoff's laboratory. The virulence of the latter was reinforced by being passed a number of times through rabbits until finally it killed the animal in doses of one-tenth of a drop administered subcutaneously. This virulency is only equalled by that of the bacillus anthracis. The culture medium employed by Répin was a bouillon of malt peptone and the serous fluid of hydrocele. The cultures were made in vacuo, and were carried on from three weeks to a month. Some were neutralized several times in the course of the growth. The culture liquids were sterilized either by heat or filtration through porcelain. In some instances fractional sterilization was employed after filtration through porcelain.

The effects of these cultures were carefully studied by Répin. When injected into the subcutaneous cellular tissue, even in the smallest dose, a burning sensation was complained of which lasted for several hours. At the end of two or three minutes an area of erythema appeared which persisted for several days. Upon the day succeeding a small, hard nodule, varying in size from that of a pea to a cherry, was found in the œdematous area, if the fluid employed was concentrated. The margins of the erythematous area were generally diffused, although in one case where the injection was made in the thigh this was absent, with a progressive tendency to extension, thus simulating a typical erysipelas. No germs, however, were present in the fluid employed, and the same liquid was employed that had been injected both previously and subsequently upon the same patient without the occurrence of this symptom. More or

[1] Op. cit.

less sensitiveness remained at the point of injection for a long time.

In order to diminish the latter Répin diluted the toxin and devised an apparatus whereby the diluted culture fluid was slowly introduced into the subcutaneous cellular tissue, the local action being thus distributed over a large surface. Under these conditions the erythema failed to appear, but painful and extensive œdema occurred.

Owing to the inconveniences arising from the subcutaneous method Répin, employed intravenous injections. These were not followed by any local disturbance, and at the same time a more prompt and decided as well as uniform general reaction was obtained.

The intensity of the general reaction obtained varied with the dose and the method of administration. The first noticeable symptom was a rigor. When the injection was made subcutaneously a larger quantity was required to produce the effect than when the intravenous method was adopted. Several centimetres were required in the former case, while a few drops were sufficient in the latter. The vascularity of these tumors explains the ease with which reaction can be produced by Coley's method of interstitial injection, this latter being quite analogous if not identical with the intravenous method. This rigor appears from fifteen minutes to two hours after the injection, and it rarely lasts longer than thirty to forty minutes.

The symptom of elevation of temperature likewise depended upon the dose. This followed the chill after from three to six hours, if the latter occurred, and in some instances reached 40° C. The fever lasted from eight to ten hours. It was accompanied by the usual correspondingly increased pulse-rate and frequency of respiration.

Cephalalgia sometimes occurred, as well as some nausea and slight vertigo. Labial herpes, sweating in the palms of the hands, and fugacious erythematous eruptions were observed in some cases in which fever was well marked.

Estimates of the amount of urea showed this at times to be somewhat lessened; albumin was not found at any period.

Examinations of the blood made ten minutes after the intravenous injections showed a slight diminution in the number of leucocytes present. The subcutaneous injections were followed by no change in this respect. Leucocytosis was occasionally observed, this being more noticeable after the intravenous injections.

Emaciation supervened very rapidly upon the use of large doses. One patient lost 5 and another 5½ kilogrammes in the first week. In proportion as the treatment is pushed this becomes more pronounced. This, according to Répin, need excite no alarm, and should not constitute sufficient justification for discontinuing the treatment if the latter is found to possess a therapeutic value.

The occurrence of small abscesses at the seat of puncture was of no greater frequency than with ordinary hypodermic injections. Répin calls attention to a special accident, namely, collapse following a sharp chill, intense headache, and cyanosis. He attributes this to the accidental puncture of a vein while employing the dosage appropriate to a subcutaneous injection, this, of course, being largely in excess of that permissible for an intravenous injection. He asserts that this was shown in one of his cases, in which these symptoms followed the injection, by the fact that a flow of blood followed the withdrawal of the needle. The remedy suggested by this accident is either to distribute the amount employed for a subcutaneous injection over a large area through several punctures, or, better still, to adopt the method of intravenous injection with the dose appropriate to that method.

In experimenting with heat-sterilized cultures it was found that when these were heated to 100° C. or more, the streptococcus toxin was considerably weakened. Three centimetres heated to 100° C. for ten minutes did not produce elevation of temperature above one degree, and but slight reaction. Six drops of the same liquid given by the intravenous method produced a slight rigor at the end of three-quarters of an hour and an elevation of temperature of one and a half degrees. The injection of a culture containing the micro-organisms, in which

the latter had been destroyed by being subjected to a temperature of 80° C. for half an hour, did not prove more effective than the same volume of the decanted fluid.

Répin's clinical observations were made in connection with Dr. Courtin and embraced four cases, three of which were sarcomas and one a mixed tumor.

The first case, a sarcoma of the posterior thoracic wall, which had twice recurred after removal, was treated by twice-daily subcutaneous injections, commencing with ten drops and reaching 105 drops finally, made at a distance from the tumor, for three weeks. A single intravenous injection was then given. The tumor was then modified in some important particulars, but the action of the toxin seemed to cease, and no final result was obtained. The tumor increased rapidly in size and finally invaded the pleura.

The second case was that of a woman with a recurrence of a "mixed tumor" in the submaxillary region, with glandular involvement, the injections producing lancinating pains in the tumor, but no objective modifications in the latter were observed.

The third case was a round-celled sarcoma. Thirteen intravenous injections, commencing with ten drops and ending with forty drops, were given. No influence upon the tumor.

The fourth case was that of a man with an enormous sarcoma of the thoracic wall of probable periosteal origin. The case was treated by the continuous subcutaneous injection method. No alterations in the growth were noticed, and but slight reaction. This was continued for a fortnight. The patient lost 5 kilogrammes in weight. Interstitial injections in the tumor were then resorted to, but these did not prove more efficacious.

The Use of the Mixed Toxins of the Streptococcus Erysipelatis and the Bacillus Prodigiosus. It was not until the discovery of Prof. Roger, of Paris, that the addition of a non-pathogenic micro-organism, the bacillus prodigiosus, to cultures of certain pathogenic organisms greatly enhanced the virulency of the latter, that another advance was made in the treatment of inoperable malignant tumors by erysipelas and its toxic products. Among the organisms, the virulency of which was

increased by the prodigiosus, was the streptococcus erysipelatis of Fehleisen. As far as could be ascertained the addition of this organism did not furnish to the cultures any specific action of its own.

Following Roger's discovery both living and sterilized cultures of the bacillus prodigiosus were employed for the purpose of inducing the development of a pathogenic micro-organism in animals relatively immune to the latter. In this connection are to be noted particularly the experiments of Vaillard,[1] Rouget,[2] and Roux,[3] who successfully inoculated the guinea-pig with tetanus, an animal ordinarily insusceptible to this disease, by combining the two organisms in the inoculation. This method apparently favors the development of the pathogenic bacillus by supplying for it a protection against the action of the phagocytes during the first few hours following the inoculation. It is claimed by Répin, however, that this action refers only to the living streptococcus and not to the toxin of the latter. He asserts that if in the hands of some observers the mixed cultures have produced a greater reaction it is because the bacillus prodigiosus itself exercises a toxic influence upon man not usually attributed to it, but that it does not necessarily follow that it exercises the same influence upon tumors as that following the reaction from the streptococcus. His method, therefore, is to employ pure cultures of the streptococcus in progressively increasing doses.

Coley, however, adopted the method of strengthening the bouillon cultures of streptococcus suggested by Roger's discovery. He very soon demonstrated its efficiency, and succeeded in obtaining more satisfactory results by mixing together the most virulent cultures of streptococcus obtainable with that of the prodigiosus cultures in the proportion of four of the former to one of the latter, sterilizing the mixture by filtration and preserving it by the addition of a few crystals of thymol. Cultivation of both germs in the same fluid was subsequently

[1] Vaillard: Ann. de l'Inst. Pasteur, Paris, 1892, vi. 676–682.
[2] Rouget: Arch. de physiol. norm. et path., Paris, 1894, 5 S., vi. 397–411.
[3] Roux: Ann. de l'Inst. Pasteur, Paris, 1893, vii. 65–140.

resorted to, and sterilization by heating to 50° to 60° C. substituted for filtration. While this permits the germs themselves to remain in the fluid, exposure of these to the above temperature is sufficient to render them sterile. The method employed in the preparation of Coley's fluid is essentially as follows:

Sterilized peptonized bouillon is inoculated with a culture forty-eight hours old, the original source of which was a fatal case of erysipelas, and the continued virulency of which has been assured by passing it through rabbits as follows: The ear of the animal is freed from hair and sterilized by washing with weak carbolic solution, followed by sterilized water. A small quantity of bouillon culture of the germ forty-eight hours old is then injected in several places in the ear. At the end of forty-eight hours the ear is again sterilized and washed, and a culture taken by introducing a stout platinum needle beneath the skin in the infected area, when the layer of skin is cut out and lifted away with the needle. The piece of skin is then used to inoculate an agar tube. If the agar is prepared with 75 per cent. of bouillon and 25 per cent. of fresh urine the growth of the colonies of streptococci will be increased. The inoculated agar tube is then placed in an incubator. At the end of twenty-four hours colonies of streptococcus will appear upon the surface of the agar. From these colonies pure cultures of the organism are obtained to inoculate the peptonized bouillon.

The best method of making the bouillon is to employ well-chopped beef, a pound of which is to be covered with water and allowed to soak over night. It is then strained through a cloth and the quantity made up to 100 c.c., when it is boiled for one hour. It is again strained, and salt and peptone added, and again boiled for an hour. The fluid will now pass through filter-paper perfectly clear, and after filtering is ready for the flasks. It need not be neutralized.

The peptonized bouillon is placed in small flasks, each containing from 50 c.c. to 100 c.c., and sterilized. It is then inoculated from the colonies upon the surface of the agar tubes, and the growth of the germ carried on for three weeks at a temperature of 30° to 35° C., after which the flask is inoculated with

the bacillus prodigiosus. The fluid is then exposed to room-temperature for another ten days, when, after being thoroughly shaken the cultures are transferred to sterilized glass-stoppered bottles. Sterilization is accomplished by exposing these to a temperature of from 50° to 60° C. for an hour.

All of Coley's patients have been treated by interstitial injections into the tumor itself. This circumstance rather enhances the value of the evidence derived from these cases. While it is true that decided effects can be produced by irritating substances substituted for the toxins, such, for instance as turpentine, as practised by Krynski, of Krakau, still the fact is settled that these are not of a curative character; further, they have no elective action upon the tumor when injected at a distance and producing the same effect, as in the case of the toxins. Once the specific action of the toxins is admitted it is highly probable that this should be exerted more energetically *in situ* than when injected at a distance.

In using the injection it is to be borne in mind that the patient may be either more than ordinarily susceptible to the action of the toxins of the germ, or he may be comparatively immune. Hence in the commencement of the treatment the dose of two minims should be employed. Dr. Coley has seen a temperature of 105° F. follow the use of this quantity. While it is true that the more decided the reaction as shown by the temperature, the better the outlook for a favorable influence upon the disease, it is not desirable that this should exceed 103° to 104° F. This is surprisingly well borne. In several instances, in spite of great depression following excessive reaction, the patient's general condition markedly improved.

The dose of the above preparation of Coley may be carried up from a half to eight minims, according to the reaction. Glycerin or sterilized water may be used for diluting the solution. If the filtrate is used the initial dose should be double that selected when the unfiltered toxins are employed. The injections may be made in the tumor itself, although it is probably safer to inject subcutaneously at first, as a larger dose will be borne if this method is employed. The injection of the toxin

solution directly into the structure of a vascular tumor leads to a more rapid absorption, and in a very feeble person may give rise to depression so great as to prove fatal. A case is reported by Moullin, that of a feeble old man with an enormous and very vascular tumor of the femur, in whom following a first injection with no marked result, a second injection was made in the tumor itself. The injections were made two days apart. Following the second injection a rigor occurred, followed by such extreme prostration that the patient never rallied. Moullin states that the second injection in all probability entered a vein.[1]

In the absence of excessive reaction of great debility the injections may be given daily, with the expectation of obtaining two or three well-marked reactions during the week. With the the occurrence of marked diminution of the growth, frequency of the injections may be diminished.

Of course, it will at once be recognized that a patient, even if not completely immune at the commencement of the treatment, may become so after the injections have been continued for a certain length of time in spite of the addition of the bacillus prodigiosus. As a result of the experience of those who have employed the method and studied its effect, it has been found that a trial of from two to three weeks will demonstrate either that some benefit will result from its use, or that it is useless to continue the treatment longer. When apparent benefit results from the treatment and there is no contraindication to its continuance, it may be kept up for three or four months, with occasional intervals of rest for three or four days.

In response to a letter of inquiry to Dr. Coley, I am indebted to him for the following:

"First, in regard to carcinoma, I have never advised the toxins in carcinoma except in a tentative and experimental way. My experience, based upon sixty cases, has led me to the following conclusions:

"The inhibitory action in carcinoma—including epithelioma—is in many cases very marked, as shown by cessation of growth, diminution in size and even disappearance of small nodules. The majority

[1] Op. cit.

of cases, however, show very little if any improvement. One case, a twice recurrent carcinoma of the breast of rapid growth, demonstrated the inhibitory action beyond question. The disease apparently disappeared. Small doses, insufficient to produce a marked reaction, were administered about twice a week almost continuously for two and one-half years, the patient gained in weight, and health was restored. At the end of two and one-half years there was a slight local return apparent in the region of the pectoral muscle. The treatment was left off for a period of five weeks during my vacation. On returning I found that a tumor, the size of a hand, had developed with enormous rapidity. In a few weeks there was evidence of recurrence in the liver and abdominal organs, and the disease advanced very rapidly, producing death in five months. The carcinomatous nature of the growth had been demonstrated by repeated microscopical examinations.

"The case of epithelioma of the chin and floor of the mouth, your own case, remains well, now upward of three years. The diagnosis in this case, as you will remember, was made from frozen sections, and although the clinical evidence strongly supports the microscopical, some will undoubtedly question the diagnosis. This latter is the only case in which the disease remained in abeyance sufficiently long to classify it as a cure.

"In view of these results, as I have stated, I practically advise the treatment only in sarcoma.

"With reference to *sarcoma*, my successes thus far are briefly as follows:

"CASE I.—Spindle-celled sarcoma of the neck and tonsil, treated with the living streptococcus. Well six years.

"CASE II.—Sarcoma of the back and groin, mixed-, round-, oval-, and spindle-celled. Entire disappearance. Well for three and a quarter years, when a recurrence took place in the mesenteric glands and liver, causing death eight months later.

"CASE III.—Sarcoma of the abdomen or pelvis, spindle-celled. Entire disappearance. Perfectly healthy at present, five years later.

"CASE IV.—Round-celled sarcoma of the iliac fossa. Almost entire disappearance. Patient well one year later.

"CASE V.—Spindle-celled sarcoma of the abdominal wall. Entire disappearance. Well four and one-half years later.

"CASE VI.—Spindle-celled sarcoma of the leg and popliteal space.

Entire disappearance. Well one and one-half years. Recurrence. Amputation of the thigh. Recurrence in gluteal region. Partial operation, continued treatment with toxins. Disappearance. Patient well at present, five years from the beginning of the treatment.

"CASE VII.—Spindle-celled sarcoma of the chest-wall of enormous size. Entire disappearance under three months' treatment. Patient well three years later.

"CASE VIII.—Angio-sarcoma of the breast, round-celled. Diagnosis made by Dr. Pruden. Entirely inoperable tumor reduced in size so that it was easily removed. Patient well about one year later when lost sight of. This case was treated with erysipelas and bacillus prodigiosus serum as well as with the toxins.

"CASE IX.—Recurrent spindle-celled sarcoma of the palm of the hand and wrist. Entire disappearance. Slight recurrence one and one-half years later. At present under treatment; tumor rapidly decreasing in size.

"CASE X.—Sarcoma of the anterior portion of the sacrum, probably osteosarcoma. Diagnosis—clinical—not confirmed by microscopical examination. Rapid emaciation; cachexia; loss of weight, thirty-five pounds in three months; lameness and excruciating pain made clinical diagnosis practically certain. Entire disappearance of the tumor with a return to normal weight after three months' treatment. Patient in perfect health two and three-quarter years later.

"CASE XI.—Sarcoma of the pectoral region and axilla, spindle-celled. Diagnosis confirmed by Drs. Denham, Buxton, and Welch, of Johns Hopkins Hospital. Entire disappearance from seventy-eight injections. Patient shown before the New York Surgical Society, November, 1896. Patient perfectly well two and one-half years after treatment. In this case the treatment was carried out by Dr. Storrs, of Hartford, under my direction.

"CASE XII.—Round-celled sarcoma of the mesentery, involving the liver and small intestine. Clinical diagnosis made by Dr. Willy Meyer at the German Hospital and confirmed by microscopic examination by the pathologist. Patient well three years later.

"CASE XIII.—Twice recurrent round-celled sarcoma of the lip—a little girl, aged five years. Disappearance. Patient well one and one-quarter years later.

"CASE XIV.—Spindle-celled sarcoma of the abdominal wall. Entire disappearance from two months' treatment. Patient perfectly well when last seen, six months later.

"CASE XV.—Enormous chondro-sarcoma of the ilium. Disappearance; restoration to health; well until seven months later, when tumor recurred and continued to grow with fatal issue ten months after.

"CASE XVI.—Three times recurrent, totally inoperable case of sarcoma of the parotid and neck. Diagnosis of spindle-celled sarcoma confirmed by microscopical examination. Entire disappearance of both tumors under three months' treatment. Patient shown before the New York Surgical Society last evening (March 24, 1894). In perfect health, without trace of disease, five months after cessation of treatment.

"I wish to merely refer to your case of probable sarcoma of the iliac fossa, the Simon boy, in which the clinical diagnosis was not confirmed by microscopical examination. The growth apparently disappeared; but about six months later a soft, fluctuating area appeared over the posterior part of the ilium, and necrosed tissue without any trace of bare bone was found on opening. Examination of the material removed was negative. He has since developed one or two areas of fluctuation further down, which seem to be either an extension of the process, or are possibly due to tubercular disease. I have been unable to find any bare bone, however, and still think the diagnosis of sarcoma the more likely.[1]

"In all the cases above enumerated, with two exceptions—the Simon boy and the sacrum case (Case X.)—the diagnosis was confirmed by careful microscopical examinations, and in most cases the diagnosis was made by more than one pathologist."

My own experience with the treatment by the mixed toxins is limited to the following case, although I have referred cases to Dr. Coley for treatment:

On December 12, 1895, I presented before the Brooklyn Surgical Society a patient upon whom I operated at St. Mary's Hospital, by external pharyngectomy, for the removal of a melano-sarcoma of the left tonsil and fauces. A recurrence took place in four weeks and after the external wound had closed. A portion of the new growth was removed and the diagnosis confirmed by the microscope. Further

[1] Since writing the above a further examination in this case confirms the original diagnosis of sarcoma.

operative interference was not deemed advisable, and he was placed under treatment by injections of Coley's fluid, prepared by Dr. Wilson at the Hoagland laboratory. Very decided reaction followed each injection, which was made deeply in the left arm; massage was employed after each injection, so as to disseminate the injected material rapidly. A sharp chill followed each injection, and a rise of temperature to 103° F. took place. There was about one day's illness following each injection. He visited the hospital each third day, received his injection, returned home and went to bed, and upon the following day, or that intervening before the time for the next injection, he pursued his occupation as a salesman. At the end of three weeks the new growth in the lateral pharyngeal wall had disappeared, and the frequency of the injections was lessened. They were given at first every four days, and finally once a week, as a prophylactic measure, for four months. At the time of exhibiting the patient, three months after discontinuing the treatment, no trace of the disease could be found.[1]

Two years afterward this patient reported himself with a recurrence of the growth. He was advised to have the toxin treatment recommenced at once, and promised to report to the hospital for that purpose. He failed to do so, however, and disappeared from my notice.

Since writing the above I have learned that this patient perished about a month ago with extensive sarcomatous infiltration of the structures of the neck on the side corresponding to the original disease of the tonsil.

C. Mansell Moullin[2] has employed the Coley fluid in ten cases. Two deaths followed the use of the mixed toxin. One of these, that of a very feeble old man of over seventy years, with an enormous and very vascular sarcoma of the femur, has been already referred to. The first injection was not followed by any conspicuous result; but the second, given two days later, led to a rigor which was followed by rapid and fatal prostration. The second case died of pyæmia, reference to which will be made later on.

Of the remaining eight cases one was a carcinoma of the breast and axilla, which showed no change. A second was a

[1] Brooklyn Medical Journal, May, 1896, p. 319.

[2] Op. cit.

lymph-sarcoma of the groin in a young man, who declined further treatment after one or two injections. A third was a similar growth in the neck of a man sixty-five years old, which was not affected, although the toxins were injected in considerable doses. Two other cases improved slightly, and in three cases the tumors disappeared.

In one of the cases the original tumor disappeared by sloughing after injections directly into the tumor. The woman was pregnant at the time. A recurrence in another locality subsequently took place.

In one of the cases in which the tumor disappeared and in which the treatment was begun in November, 1895, the patient was seen in March, 1896, when it was stated that there was very little of the tumor to be felt. In November, 1897, two years from the commencement of the treatment, no tumor was present, and the patient was in good health.

In another of the successful cases the treatment was commenced in November, 1896, and the patient was shown at the London Medical Society in November, 1897, one year later. The tumor, which had existed in the left loin, had disappeared.

In the third successful case the patient had a tumor of the hip of four months' duration. The swelling of the hip diminished slowly at first, and subsequently more rapidly. An abscess subsequently formed and opened spontaneously. A year later there was no recurrence.

It is to be regretted that in Moullin's three cases in which the tumors disappeared there was no microscopical examination made, and hence the proper proof that they were indubitably sarcoma is wanting. They were diagnosticated as such by others, as well as himself, and Moullin declares that if they were not sarcomas it is impossible to say what they could have been.

Dr. W. B. Johnson,[1] of Paterson, N. J., reports a case of very large spindle-celled sarcoma of the pharynx which disappeared entirely under the mixed toxin treatment, and was well when

[1] New York Medical Record, November, 1894, p. 616.

last seen, three years later. This case was seen in consultation by Dr. Coley, and the treatment was directed by the latter.

Dr. R. M. Stone,[1] of Omaha, reports an inoperable sarcoma of the uterus which disappeared under treatment, the patient being now well, two years later.

The principal interest in the question notably involves the application of the treatment to sarcoma, since it is now generally admitted that in a large majority of cases carcinoma will not yield in a sufficient number to warrant its employment save as a forlorn hope.

Dr. Coley has kindly placed at my disposal his statistics, which may be briefly summarized as follows:

Total number treated, 125. Of these 76 were round-celled; 17 spindle-celled; 5 mixed-celled; 8 melanotic round-celled; 2 chondrosarcoma; 11 sarcoma in which the type of cell was not given, and 6 were cases of inoperable sarcoma in which a purely clinical diagnosis was made.

An analysis of the effects of the treatment upon the different types reveals the following:

Round-celled sarcoma, 76 cases. Of these in only 2 did the tumors disappear under treatment. Of the remaining 74, 38 were not appreciably affected by the treatment; in 36 more or less improvement was noted.

Spindle-celled sarcoma, 16 cases. Of these 9 disappeared entirely; in the remaining 7 marked improvement was manifested. In not a single case of this type of the disease was there failure to bring about marked changes in the growth.

Mixed-celled sarcoma, 5 cases. In one case in this group the growth disappeared entirely, remained for three and one-quarter years, and then recurred; 3 of the cases were improved, and 1 was unimproved.

Melanotic sarcoma, 8 cases. Of this group 2 cases showed slight improvement, while the remaining 6 were unaffected by the treatment.

Chondrosarcoma, 2 cases. One of these, a very large growth,

[1] Loc. cit., November 20, 1896, p. 746.

disappeared and recurred at the end of seven months. The other was slightly improved.

Sarcoma (type of cell unknown). Of these 1 case disappeared entirely; 5 were improved, and 5 were unimproved.

In addition to those cases in which a microscopical diagnosis was made the 6 cases of inoperable sarcoma in which a clinical diagnosis was made should be taken into account. Of these 2 were of osteosarcoma, in one of which the tumor disappeared; in the other improvement was noted. In the remaining 4 cases the growths sprang from the soft parts; 2 of these were improved, and in 2 cases no improvement was apparent.

In the grand summary it may be stated that in 16 cases the tumors disappeared entirely, and that in but one of these was the crucial test of a microscopical diagnosis wanting.

Of the 16 cases, 14 have been traced, with the following result:

Spindle-celled Sarcoma. Nine of the fourteen cases were of this type. A study of the after-history of these reveals the following: One case remains well after eight years. This case was treated with living cultures of the streptococcus erysipelatis. One case remains well at the end of four years. One case is well after three and one-half years. One case is still free from the disease after two years and ten months. One case remains well after one and one-quarter years. One case relapsed in eight months and again disappeared under treatment. One case recurred in six months and again disappeared under treatment. One case is well at the end of five months.

Mixed-celled Sarcoma. In the only case of this type in which the tumor disappeared the patient remained well for three and one-half years. She then suffered a recurrence in the abdomen, of which she died in April, 1897.

Chondrosarcoma. But one case of this type occurred in the 16 cases included among those in which the tumor disappeared. Recurrence took place in seven months.

Osteosarcoma, 1 case. This is the only case of sarcoma in the list in which a microscopical diagnosis was not made. Clinically it was a case of inoperable sarcoma of the sacrum. The patient continues well after two years.

Round-celled sarcoma, 2 cases. One case remains well two and one-half years after the disappearance of the tumor. The remaining case was well when last heard from, three months after the treatment.

It will be noted that not all of the cases of carcinoma in which the treatment by the mixed toxins has been tried have proved absolute failures in Dr. Coley's hands. In my own case, that of an inoperable epithelioma of the chin and floor of the mouth, referred by myself to Dr. Coley for treatment, the patient remains well three years since the beginning of the treatment. In a second case, that of an epithelioma of the face, the disease disappeared, but recurred within a year. A third case was one of recurrent carcinoma of the breast, which with constant treatment for two and one-half years remained free from evidences of the disease.

Since the preparation of the above Dr. Coley informs me that he has treated fifteen additional cases of sarcoma with the mixed toxins, with one entire success, and one case in which the tumor almost entirely disappeared. This makes a total of 140 cases of sarcoma, in 17 of which there was a complete disappearance of the growth. Of the cases which have not relapsed 1 has exceeded the four-year limit; 1 has exceeded the three-year limit, and 2 have exceeded the two-year limit. In addition to this 1 has passed the year limit, with no sign of recurrence, and is still under observation, with no recurrence, and 2 are respectively two and five months each free from recurrence after cessation of the treatment.

Of those that recurred, the longest time that the patient was free from the disease was three and one-quarter years, when a recurrence in the abdomen resulted fatally. The shortest time that the patient remained well after complete disapearance was six months. In one case of recurrence the tumors disappeared a second time under the toxins.

In one of Coley's cases, that of a round-celled angiosarcoma of the mamma, the tumor was so greatly reduced in size that it became an operable case and was extirpated. The patient was lost sight of at the end of six months, at which time no recur-

rence had taken place. It should be stated in this connection that the case was treated with the erysipelas-prodigiosus *serum*.

Of twenty-six cases treated by other surgeons by Coley's fluid, collected and studied by him, the following is a brief summary:

Spindle-celled sarcoma, 6 cases. 5 of these disappeared and 1 was improved.

Round-celled sarcoma, 9 cases. Of these 7 disappeared and 2 were improved.

Sarcoma; type not mentioned, but diagnosis confirmed by microscopical examination, 5 cases; 3 disappeared.

Sarcoma; clinical diagnosis alone. 2 disappeared and 2 were improved.

Of the above cases one is known to be well more than three years; one more than two years, and one is still free from the disease at one and one-half years.

Dangers of the Treatment. The dangers arising from the supervention of an accidental attack of erysipelas, the inoculation of a patient directly from a case of the disease, or with living cultures of the streptococcus erysipelatis, need not detain us at this time. The risks attending these methods are essentially those incident to erysipelas itself occurring in a patient the subject of a malignant disease, and whose vital powers are already taxed to the utmost in maintaining an unequal combat against local extension and general invasion. Since these procedures have been practically abandoned for the less uncertain methods involving the use of toxins in either pure cultures of the erysipelas germ or mixed cultures of this with the bacillus prodigiosus, our attention may be most profitably turned to the latter.

First, it should be borne in mind that the reaction depends upon the dosage of the toxins. Unlike most other therapeutic agents animal toxins vary very greatly in their effects upon different individuals, so much so that it becomes necessary to establish the dose in each case by commencing with the minimum amount that experience has shown will produce an effect in those the most susceptible. In this manner safety within

certain limits is assured, although a greater expenditure of time is necessary in bringing the patient under the full influence of these agents.

In the employment of the mixed toxins, according to Coley's experience, it is better to commence with a dose as small as one-quarter of a minim, increasing this at each administration until the effects of the toxins are assured. Profound depression is not desirable, nor need this occur, save under the exceptional circumstances of a patient so near to death that no treatment whatever should be employed. To give an initial dose under these circumstances that would produce any reaction whatever would be to invite collapse. This was evidently the condition present in one of Moullin's fatal cases previously mentioned, a very feeble man of seventy years, with an enormous and very vascular sarcoma of the thigh.

This latter condition may likewise be brought about in those not too far gone, in an over-anxiety to hurry the treatment by using too large a dose to commence with. In all the reported cases of alarming collapse following very severe reaction a larger dose than that mentioned was employed. This includes Répin's case, as well as that of Johnson. It would be just as rational to discard the use of any therapeutic remedy for the sole reason that in some instances it had been employed in unnecessarily large or too frequent doses.

There is one possible danger pointed out by Moullin,[1] suggested by an experience in the use of toxins in a case of a breaking-down sarcoma with necrosis of bone and suppuration, in which death resulted from pyæmia. The syringe was carefully sterilized and the injected fluid was likewise shown to be sterile. In addition to this the fluid from the same bottle was used upon the same day in another patient. The explanation offered by Moullin seems rational. It is that the use of the bacillus prodigiosus in a case in which suppuration was present either destroyed the immunity which the patient had acquired to the pyogenic organisms, or increased the virulency of the

[1] Op. cit.

latter, or both, properties the possession of which led Coley to add it to the streptococcus toxin in order to enhance the effect of the latter.

A similar experience occurred to Mr. Marmaduke Shield.[1] In the last-mentioned case the patient had been operated upon for a rapidly-growing myeloid sarcoma of the left breast. A recurrence in the axilla and beneath the clavicle, as well as in the scar of the original wound, had taken place. One of two growths in the scar was on the point of breaking down. The patient's general health and nutrition were good. Eight injections, with gradual increase in the dose, were given, but a week was allowed to elapse between the first five and the remaining three. The autopsy showed infarcts and abscesses in the liver, myocardium, kidneys, and right knee-joint, together with a purulent infiltration of the muscles of the thoracic wall beneath the site of the two nodules in the scar, which had disappeared under the treatment. A bacteriological examination showed the presence of the staphylococcus aureus in the secondary abscesses. In this, as in Moullin's case, proper aseptic precautions were taken in making the injections; the fluid employed was found to be sterile, and injections had been made upon another patient from the same bottle with little or no reaction.

These experiences would seem to indicate the necessity for a careful selection of cases with the view of eliminating those in which suppurative processes are in progress.

The Question of Habituation. In this connection the researches of Marmorek should be borne in mind. These consisted in the employment of injections of increasing doses of streptococcus toxin into animals with a view of finally rendering the latter immune, to the end that a serum might be obtained from the immunized animal to be employed in the treatment of streptococcus infection.

There can be no question that the general effects of the toxins become rapidly less pronounced in the course of the treatment, as immunization becomes established. While, early in

[1] British Medical Journal, January, 1897.

the treatment, a comparatively small dose of the toxin is sufficient to produce a decided rise of temperature, this, in some instances has been increased, after a few injections, to double, and upon occasion to quadruple, the original dose in order to obtain the same effect.

Inasmuch as the local action upon the tumors follows a course parallel with the intensity of the general reaction, it necessarily follows that as immunization is established the effect upon the growth becomes less and less marked, until at last this becomes *nil*, and the neoplasm, released from the restraint exercised upon it by the toxins, resumes its former progressive march. It is not infrequently observed that a tumor which had shown marked modifications in connection with an intense and high grade of general reaction, as immunization becomes established and the former ceases to be manifested, may fail to show signs of amelioration, and in a short time give decided evidence of increasing growth. It is the unfortunate existence of a previous immunization, either natural or acquired, in individual cases that leads to lack of uniformity in effects in the commencement of the treatment. Upon the same theory is likewise to be explained the fact that some cases that give promise of a happy issue in the commencement of the treatment come to a standstill, and finally become the subjects of a recrudescence. It is this immunization which limits the efficacy of the treatment of malignant tumors by the streptococcus erysipelatis. On the other hand, there are subjects who either do not become immune at all, or do so with great difficulty. In this manner are to be explained the lasting cures that have been recorded as resulting from a prolonged course of treatment.

The Condition of the Tumors Under the Influence of the Erysipelas. Observations bearing upon this point are yet insufficient in number to form a basis upon which to build up a rational theory as to the modus operandi of the process of absorption or other means through which the disappearance of the tumors is brought about. In the only fatal case of sarcoma, that of Busch, in which a post-mortem examination following death from accidental erysipelas, in the course of which the

tumor was disappearing, was made, the streptococcus was present, as was to have been expected. All that remained of the structure of the tumor at its central portion, where the changes were most marked, was represented by connective tissue, which contained in its interstices a large amount of yellowish fluid. The characteristic sarcoma cells were absent, having probably undergone fatty degeneration, and their place was supplied by this yellowish-white, opaque fluid, which contained a number of fat granules. In the outlying parts of the growth, areas still unaffected by the changes going on in the central portion could be distinguished, and served well for purposes of comparison, as well as to identify the nature of the growth.

Of the cases of carcinoma examined after death from erysipelas one is that of Neelsen.[1] Here the anatomical modifications brought about by an attack of erysipelas in a carcinoma of the mamma were the subject of histological investigation. The patient died from the excessive febrile movement. At the post-mortem it was found that the tumor was partially destroyed. In certain places the epithelial alveoli had undergone fatty degeneration. In other places necrosis had taken place, leaving only débris. The walls of the empty alveoli were crowded together in spots by a new and abundant proliferation of young epithelial cells. The latter extended also into the regions adjacent to the tumor, and especially into the skin. It is to be regretted that in this connection Neelsen did not make a bacteriological investigation.

Janike's case was also one of carcinoma. Here particular attention was paid by Neisser, who made the examination, to the invasion of the streptococci. The micro-organisms were found between the cell nests, and surrounding the latter, although actual penetration of the cells themselves was not demonstrated. With the exception that the latter were paler and less distinct, suggestive of a commencing coagulation necrosis, the carcinomatous cells showed but little change. Certainly no evidences of inflammatory change were observed.

[1] Centralblatt für Chirurg., 1884, No. 44.

On the other hand, in Shields' fatal case,[1] the statement is made that the well-marked effect upon two of the tumors, and which led to their disappearance, seemed to be due to a purely inflammatory action in a soft neoplasm. It should be noted, however, in this connection that a suppurative process was present, and that the post-mortem likewise revealed a purulent infiltration of the thoracic wall beneath the site of the two nodules which had disappeared.

Spronck, in the course of his experiments upon dogs, found fatty degeneration to be present in tumors removed from animals while under treatment with erysipelas toxins.

So far as our present knowledge of the processes by means of which malignant tumors disappear under the influence of erysipelas extends, these include (1) sloughing *en masse;* (2) a rapidly destructive degenerative process, comparable, as observed by Moullin, to acute yellow atrophy of the liver, and which for want of a better name, may be called fatty degeneration. These processes are known to have occurred in malignant growths of connective tissue origin, or, in other words, the sarcomata. It has been suggested that these two processes depend, the first upon the presence of pyogenic organisms, such as are present in growths already breaking down, or under circumstances where these can give access to the growth, as through an accidental abrasion; and the second upon the absence of these micro-organisms. The first is of the nature of a septic while the second is an aseptic process. In the presence of the former the inflammatory changes with sloughing of the growth in whole or in part constitute the prominent features, while in the latter, although there may be some redness about the tumor at first, and some increase in size as well, softening occurs, the color fades out, and the surfaces flatten; in some instances a hollow may be left at the former site of the tumor.

On the other hand, the changes observed in carcinoma differ somewhat from the foregoing in degree, although the same

[1] Op. cit.

process of fatty degeneration seemed to be present in Neelsen's case, according to his description of the histological findings. In addition, however, there appeared a new cell-growth, the exact relation of which to the destructive process does not seem apparent. In Neisser's examination of Janike's case the former came to the conclusion that a partial destruction of the cell nests of carcinomatous tissue resulted from the invasion of the streptococci, this being not necessarily accompanied by an inflammatory process. It is possible that the conditions observed by Neelsen and those found by Neisser were but different stages of the same process, and that the incompleteness of the latter, as well as the presence of the new formation tissue in the former explains the differences in the behavior of the two varieties of malignant growth under discussion, in the presence of erysipelas or its toxins, the one furnishing the most frequent successes, the other the most frequent failures of the treatment.

The Rationale of the Action of the Streptococcus Erysipelatis and its Toxin. The consideration of the rationale of the action of the streptococcus erysipelatis and its toxins upon the life-history of malignant tumors constitutes the most important as well as the most obscure portion of the subject. Among the older observers who noted the curative action of accidental erysipelas, the prevalent theory, unsatisfactory as it appears to us at the present day, was that the superadded disease exercised a special or superactive function which accompanied the convalescence of acute febrile diseases. This, however, in no measure explains the elective action of this disease for malignant neoplasms, nor why curative influences exerted over the latter were reserved almost exclusively for erysipelas.

In the first contributions upon the subject, and before the fact that the toxins exercised a decided influence upon the growths without the presence of the germs it was believed that the coccus excited a direct destructive action upon the cells of the neoplasm. In the light of later development this theory is no longer tenable, even though it might have been worthy of consideration in the past. Certainly it was not sufficient to account for all the phenomena in the different cases.

Another theory of the rationale of the cure relates to the occurrence of the high temperature resulting from the treatment, and the influence which this exerts over the vitality of the cells. Bruns was inclined to this view; but it is difficult to understand why conditions unfavorable to cell-life created by the fever of erysipelas should differ in any respect from those arising from fever the result of other diseases. A number of conditions involving the febrile state are now known to depend upon specific organisms, to say nothing of septo-pyæmic conditions occurring in the history of the tumors themselves involving high temperature; it is yet to be shown that these have any influence upon the growth of tumors. As a matter of fact, it is the common experience that general infection, including fever, and excessive malignancy of the breaking-down growths, go hand-in-hand.

The supposed parasitic origin of cancer has given rise to the theory that the modifying influence of the erysipelas germ is a result of a direct antagonistic effect upon the micro-organisms of the neoplasms.[1]

The exact manner in which this antagonistic bacterial action is exercised is not, however, made clear, although, according to its author, if we accept the micro-parasitic origin of malignant tumors, an explanation of the action is not difficult, and example and analogy are drawn from the well-known fact that "a small quantity of blood-serum of an animal rendered immune to tetanus is capable of destroying or rendering inert the virulent bacilli in a fresh case." In the present state of knowledge regarding susceptibility and immunity, this analogy cannot hold good, for the reason that in the one case the effects depend upon the introduction of an immunizing principle, secured through the influence of a toxic agent, or, in other words, an antitoxin, while in the other the toxic principle itself is introduced, and with the end only too frequently of producing an undesirable immunization instead of a persistence of the toxic effects, upon which the amelioration apparently depends. If

[1] Coley: Annals of Surgery, vol. xiv. p. 217. The American Journal of the Medical Sciences, May, 1893, p. 500; July, 1894, p. 62; September, 1886, p. 279.

immunization plays any rôle whatever, it must almost of necessity either result from the effects of the streptococcus or its toxins in securing immunity against its own products or those of the parasites of the growth, or both. That the former is true is shown by Marmorek's work; that the latter is possible cannot be denied. Neither, however, can satisfactorily explain the local effects upon the tumors, even though they could be brought to suggest a reason for an inhibition of growth on the part of the latter or the prevention of a recurrence after removal.

While the ground taken by Coley cannot be considered as absolutely untenable, the fact that the parasitic origin of cancer is considered as being largely hypothetical at this time, on the one hand, and on the other, the absence of uniformity of results, such as have been obtained experimentally in tetanus and clinically in diphtheria, must of themselves militate largely against it, even though theoretical considerations be left out of the question. To this is to be added the fact that in the class of cases under consideration, the toxins, so far as their immunizing effect is concerned, always act slowly, and with the necessity of increasingly large doses in order to produce a repetition of a primary intense effect. On the contrary, their toxic effect, both general and local, is immediate and *pari passu* with the constitutional disturbances; the tumor softens and shows other evidences of necrobiosis in from twenty-four to forty-eight hours. Further, the primary maximum effect is reached at once, is short in its duration, and is frequently difficult of reproduction after it has subsided. Finally, with the immunization to the streptococcus itself comes a cessation of immunization to the micro-organism of cancer, if such exists, since a renewal of the growth of the latter, if it has not disappeared, as a rule, follows very quickly. This peculiar circumstance of a cessation of one property of immunization coincidently with the development of of another has probably no analogue in bacteriological experience, although a number of examples of both micro-organisms and toxins are known, which produce immunization against themselves as well as against other micro-organisms and toxins.

According to the view of Répin, an elective intoxication of

the cells of the neoplastic tissue occurs. It must be confessed that the processes of fatty degeneration, necrosis, and finally the resorption and elimination of the necrotic elements, lesions histologically observed, more closely approximate to results that may be supposed to follow a direct toxic effect upon the cells, than to the hypothesis of the action of one parasite upon another. The clinical evidence likewise favors this view. In all cases of cure or amelioration the effects of the erysipelas or its products have assumed a hypertoxic form, the more pronounced the so-called reaction the greater the hope of success of the treatment. Failure to effect reaction signifies that no effect upon the tumor is to be expected, and inability to reproduce successively the symptoms of intoxication is followed by recrudescence, in which all the previous characteristics of the growth are restored.

Répin emphasizes the view of cell intoxication by calling attention to the analogous action of tuberculin, the use of which is followed by a limitation of the characteristic action on tuberculous tissues as far as producing necrosis and the elimination of this tissue is concerned.

The elective action of certain medicinal agents and the mild or excessive toxicity of these in proportion to the dosage and toleration established to certain tissues, constitute an example of elective cell intoxication. This affinity of tuberculin for tuberculous tissue is explained by the fact that the cells of the latter acquire a susceptibility for the products of the tubercle bacillus from having been in permanent contact with the latter. The fact is also to be recalled that when a person is bitten a second time by a venomous serpent, even after several years following the first infection, the scar of the former wound presents evidences of irritation as if the cells which were affected by the venom retained for a long time a special susceptibility in this respect. A similar experience attended the treatment of a case of sarcoma of the tonsil by the venom of the cobra capello (Répin). The effects of the streptococcus in producing emaciation with destruction of the red blood-corpuscles and increase of the leucocytes is also duplicated in the case of some

of those agents when pushed to the extent of producing a local action, as, for instance, in the case of arsenic when this remedy is administered to the extent of obtaining amelioration in cases of lymphosarcoma and lymphadenoma. Further, with interruption of the treatment the symptoms of chronic poisoning subside, the general health is restored, while at the same time the tumors take up their original growth.

Further, it should be borne in mind that the locus minoris resistentiæ incident to all local diseased conditions must play a part in the alterations manifested by the effects of all remedies. In order to establish an elective action the previous presence in diseased structures of parasitic organisms, or their impregnation by specific poisons, is not necessary. The fact that large tumors and those that existed for a longer time, and even those in process of breaking down, yield more readily than those smaller in size and of more recent growth, suggests that the cells of the former, from their great age, possess a lower vital resistance, and hence break down more readily under the influence of the intoxication than those of more recent origin. The youngest cells of the neoplasm in all probability escape the influence of the poison during the susceptible period and prior to failure to obtain reaction. The tumor is thus only partially destroyed and increases rapidly in size. This constitutes the weak point in the method.

Finally, it must be acknowledged that these reflections upon the influences exercised by the establishing of a locus minoris resistentiæ hold good to a greater or lesser extent, and in a variable manner, in their relation to direct destructive action upon the cells of the new growth by the streptococcus erysipelatis, the effects of high temperature, antagonistic bacterial action, as well as elective toxic influences.

Treatment with the Toxic Blood-serum of Animals Infected with Streptococcus Erysipelatis. In this method of toxitherapy the toxin is produced from the blood of an infected animal instead of from a bouillon culture. Répin claims to have employed toxins derived from the blood of rabbits killed by inoculation by the streptococcus. The first published account

of this method is by Emmerich.[1] His method consists in inoculating a sheep with a virulent streptococcus and bleeding it just before its death. The serum obtained is first filtered and then injected into the tumors. The injection is followed by a pseudo-erysipelas at the point of inoculation with elevation of temperature. Six cases, in which an appreciable effect upon the tumor was obtained, were treated by Emmerich as follows:

Case I.—Recurrent carcinoma of the breast in a patient aged fifty-four years: recurrence at site of scar and in the axilla; induration of pectoral muscle and subclavicular fossa. Right arm œdematous and useless. Injections of 0.5 c.c. of the serum in the course of two days; tumor diminished in size fully one-half. Dose increased so that at the end of the third day the patient had received 2 c.c., when the tumor, as well as the infiltration of the pectoral, disappeared entirely. In the meanwhile the axillary involvement suppurated, and was incised. The treatment was continued in diminished doses for twenty-five days in all, when all traces of the recurrence had disappeared. At the end of this time there occurred a pathological fracture of the clavicle, which, however, united. At the end of nine weeks the patient was dismissed in good health, and with the function of the arm restored.

Case II.—Recurrent carcinoma of the breast; tumor size of hen's egg at the cicatrix, and three small scattered cutaneous nodules; daily injections of from 3 to 5 c.c. were made for a week into the principal tumor, without any effect upon the tumor injected, but the outlying nodules disappeared under the treatment.

Case III.—Recurrent carcinoma of the breast, with metatasis in the liver and pleura; after ten days of treatment and the injection of 30 c.c. of the serum, one small nodule, the size of a cherry, had disappeared, and no further effect was obtained. The treatment was abandoned.

Case IV.—Relapsing carcinoma of breast with cutaneous nodule in axilla; after fourteen days' treatment and the injection of 20 c.c. of serum, the cutaneous nodule was resorbed. Patient still under treatment.

Case V.—Large carcinoma of breast with extensive axillary glandular involvement; 60 c.c. injected into the tumor and into the glands

[1] Deutsche medicinische Woch., April 25, 1895.

in the course of sixteen days; the glands diminished in size fully one-half; the effect upon the tumor was not so marked, this diminishing in size but slightly. The use of the serum was discontinued.

Case VI.—Ulcerating cancroid of the external palpebral commissure in a woman aged sixty-five years; local injections of the serum; growth disappeared and cicatrizing ulceration took its place.

The Use of the Venom of the Cobra Capello. It has long been known that the venom of the cobra capello produces remarkable modifications in the nutrition of the parts bitten, such, for instance, as the atrophy of a member. Cures of leprosy and elephantiasis are also alleged to have followed inoculation with this poison; in some instances the victims of these diseases having purposely exposed themselves to being bitten in the hope of cure. The attempts to derive therapeutic action from this source is said to be devoid of danger, if proper precautions are taken. These latter consist of the employment of a minute dose at the commencement, habituation becoming established by the steady increase in the size of the dose. Calmette was the first to succeed in the methodical immunization of animals, and the production of an antivenomous serum.

The dry venom of the cobra capello was employed by Répin in doses of one-fortieth of a milligramme, injected beneath the skin in the pectoral region in a case of sarcoma of the tonsil. The size of the dose was gradually increased so that in the course of a fortnight a dose of 7 milligrammes was reached. No febrile reaction occurred. The weight of the patient increased 2 kilogrammes during that period. These injections produced painful sensations in the tumor similar to those following the streptococcus toxin. No objective alterations in the growth were noted. When the dose was increased rather abruptly it was observed that the seat of preceding injections, which had long ceased to be painful, even upon pressure, again became as painful as they were upon the day when the injection was made.

The Influence of Artificially Produced Suppuration upon Malignant Growths. The subject of the induction of nutritive changes by artificially produced suppuration in malig-

nant disease, with the view of influencing these favorably has received some attention at the hands of experimental observers. Kryński, of Krakau,[1] endeavored to demonstrate the influence of artificially provoked a septic suppuration upon the course of malignant neoplasms. He was induced to make these experiments by the occurrence of a case of malignant goitre, a portion only of which was removed to relieve pressure upon the trachea and impending suffocation. Owing to the necessity for reopening the wound, on account of subsequent hemorrhage, an abundant suppuration followed and continued for several weeks. During this time the greater portion of the remainder of the growth was cast off, healing finally taking place with a small nodule still existing and marking the site of the formerly existing extensive growth. The patient left the clinic, and with the latter exception was apparently well, but was known to have perished from the disease three months later. Upon the basis of this experience Kryński resolved to ascertain whether or not suppurative changes of an aseptic character, with its comparative absence of danger would, when artificially produced, favorably influence the growth of malignant disease. In two cases of advanced carcinoma of the breast in which trial was made of the injection of oil of turpentine, for the purpose of inducing aseptic suppuration, no result was obtained save the infliction of considerable suffering upon the patients. Although necrotic tissue was thrown off from the diseased area when suppuration was well established, the disease continued to make steady advance in the neighboring structures.

On the other hand, Wyeth[2] records an instance of a growth in the abdominal wall in a patient, aged thirty-three years, which was apparently cured by a suppurative inflammatory process. A large portion of the tumor was removed by operation and pronounced by Prof. Welch, now of Johns Hopkins University, as well as by Dr. William L. Wardwell, as sarcoma. It was found impossible to remove the entire growth, and the wound made was tamponed and the operation abandoned. Arsenous

[1] Centralblatt für Chirurgie, 1895, No. 30, pp. 697–99.

[2] Journal of the American Medical Association, June 30, 1894, p. 985.

acid was subsequently injected into isolated areas in the remaining portion of the growth with the view of obtaining some specific action from this agent. Before all portions of the growth had been subjected to this treatment a violent suppurative inflammatory action occurred, and the treatment was abandoned. No hope was entertained of his recovery. The process of suppuration continued for several weeks, when it gradually ceased, the tumor finally disappearing. Ten years afterward he was known to be free from a recurrence of the disease. In commenting upon the case, Dr. Wyeth states that there was no erysipelas present, and that the case was positively one of sarcoma cured by the action of other septic or toxic agents of inflammation.

A CLINICAL AND HISTOLOGICAL STUDY OF CERTAIN ADENOCARCINOMATA OF THE BREAST:

And a Brief Consideration of the Supraclavicular Operation and of the Results of Operations for Cancer of the Breast from 1889 to 1898 at the Johns Hopkins Hospital.

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When our Secretary, Dr. Burrell, graciously urged me to introduce the subject of breast cancer for discussion at this meeting, and to tell you something of the results of our experience in the treatment of this disease, it seemed to me that it would be a very simple matter, for our cases have been many and our interest in them great.

It would be profitable, I thought, to review with you some of our work from a pathological, as well as a clinical stand-point, with a view to determine, as far as possible, the relative malignancy of the various cancers of the breast. For the physician, as well as the layman, a cancer of the breast is a cancer of the breast, and efforts to classify these tumors have not been very successful. But the riches of our cancer storehouse embarrass me, and I prefer in the time allotted to ask your attention to the description of one or two quite rare but definite varieties of breast cancer which we have encountered with sufficient frequency to enable us to recognize them clinically as well as histologically.

We have truly a cancer storehouse, for we save all of our malignant tumor material. In breast cases the entire mass—

fat, muscle and all—is saved. Before it is severed from the body, in the course of the dissection, ligatures black and white are placed in it, here and there, as landmarks. When a flap of skin is to be dissected back its tip is left in situ, as a bearing point on the tissues to be removed. If by accident or design a scrap of tissue is dissected during the operation from the tumor mass, it is at once labelled. When we are in doubt as to the cancerous involvement of the minute gland at the highest reachable point below the clavicle, it is sometimes dissociated by a special ligature. In making the incisions for the macroscopic examination of the tumor the best interests of the microscopic work are considered. We are, if possible, more fully convinced than ever of the value of painstaking scrutiny of the naked-eye appearances, and of detailed descriptions of all that can be seen on the freshly cut surfaces of the tumor and of the appearance and relation of the outlying parts. We have had occasion to regret the fact that the macroscopic findings have been insufficiently portrayed in some few of our earlier cases.

The block dissected from the neck, and eventually from the mediastinum, should be oriented, before hardening, as accurately as the main mass. The tissues should be hardened in Müller's or Zenker's fluid rather than in formalin or alcohol. If formalin should seem desirable in some special case, it might be used for three or four hours, after which Müller's fluid is to be substituted. Formalin interferes with the differentiation of elastic tissues by the orcein stain.[1]

One person should be responsible for the preservation of the breast material from first to last. This was no light responsibility, even when the material was not nearly so abundant with us as it is at present.

Above all, the operator himself should study the material, in the operating-room, immediately after the operation, and in the laboratory.

There is a gap between the surgeon and pathologist which

[1] E. Goldmann. Beitrage zur klin. Chirurgie. Bd. xviii. p. 595.

can be filled only by the surgeon. The pathologist seldom has the opportunity to see diseased conditions as the surgeon sees them. A tumor on a plate and a tumor in the breast of a patient, how different! Its blood, its color, its form, its freshness, its consistency, are more or less lost when the tumor has been removed; the translucent zone of certain rapidly-growing cancers soon becomes opaque. Furthermore, the gross appearance of the new growth has for the surgeon a vital interest. He must decide at the operating-table not only what is to be done at the moment, but he should be able to give a more or less accurate prognosis. If there is a difference in the malignancy of malignant tumors the operator, above all others, is the one to whom we should look for its interpretation. Not only are his opportunities greater than the pathologist's, but the incentive for the study of the fresh as well as of the hardened specimen is infinitely greater.

The patient's first impressions of the tumor, the presence or absence of pain at the beginning, the gradual increase of pain from almost imperceptible beginnings, the life of the new growth, the gradual disappearance of the fat between tumor and skin, the discoloration of the skin over the tumor or in its neighborhood, the local changes in the venous, arterial, capillary, and lymphatic circulations, the involvement of the skin and of the parts underlying the tumor, the shape and appearance of the tumor, the condition of the nipple as compared with its fellow, the gradual shifting of nipple (it may reach the axillary line), the comparison of the two breasts, of the axillæ, of the supraclavicular fossæ and of the groins, the circulation of the arm of the affected side, the involvement of the skin by metastases, of the pleura, bones, and viscera, etc., these are some of the conditions which interest the operator more than the pathologist, and may assist him ultimately in connection with his study of the new growth itself to make some sort of a classification of breast cancers, and to determine their relative malignancy.

That breast cancers are not all alike every clinician knows; to some the patient succumbs in a year or less, others are borne for twenty years or more.

I know of no very successful attempt at classification of cancers of the breast with reference to their relative malignancy, and yet the importance of such a classification, if it were to any extent possible, is so evident that it is unnecessary to emphasize it. The histories alone of the operated as well as the unoperated cases give one a hint that there must be some basis for such a classification.

Many cancers of the breast contribute little if anything to the size of the organ, but some, certain adenocarcinomata and encephaloid cancers for example, form tumors with considerable dimensions; the latter may exhibit a slight tendency to pedunculation.

I find myself becoming inclined to welcome largeness, a suggestion of constriction at the base of cancers of the breast, and a tendency to break down as relatively favorable signs.

It would seem that we have been fortunate in meeting with a number of unusual adenocarcinomata, some of which have, perhaps, never been described; they may, however, have been seen and even described, but described beyond recognition. I have read long and careful descriptions of the minute appearances of tumors which might be interpreted to mean almost anything. If drawings were to be made by several individuals based on some of these descriptions, I doubt if any two of them would depict the same thing.

The particular adenocarcinomata which are so full of interest for us at this time, and to which I shall first call your attention, I do not find described; and yet they are not so very uncommon. We have encountered five or six of them in less than 150 cases of breast cancer.

Permit me to proceed at once to a very brief consideration of these cases:

Case I. *Malignant adenoma* (*adenocarcinoma*). Surg. No. 6286; Path. No. 1705. Mrs. L. M., white, aged sixty-seven years, presented herself February 16, 1897, with a tumor growing in the site of a scar over the right breast. Two and one-half years before admission the patient struck her right breast in a fall; one month thereafter she noticed in this breast a little lump, the size of a pea, just under the

skin. Within a year the tumor grew painlessly to be as large as a fist. Eight months before admission the tumor was removed by a local surgeon. At that time the skin over the tumor was bluish but not broken. Since the operation there has been a rapid recurrence of the tumor, associated with occasional sharp shooting pains. There has been no loss of weight or strength.

This patient was presented to me for the first time at my clinic, where I discussed the tumor, at length, before the class. It was a fungating tumor, pedunculated, and occupied the lower portion of the scar. There was also a small nodule in the upper end of the scar (see Plate I.).

The entire convex surface of the tumor was ulcerated. One could squeeze a serum-like fluid from the tumor, the surface of which was covered by a necrotic film. I told the class that the tumor was certainly not an ordinary carcinoma, because of the considerable pedunculation, the peculiar serous fluid, the consistence of the tumor, etc. It was softer than the ordinary carcinoma of the breast, considerably softer everywhere except in one place, and this particular place, which was harder and could not macroscopically be distinguished from carcinoma, proved microscopically to be an adenocarcinoma in which the cells had already ceased to form any very definite combination figures The tumor was removed at this same clinic by Dr. Finney, and the axilla was dissected out in the usual way. The glands in the axilla were enlarged, but careful microscopical examination of several of them has thus far failed to furnish evidence of carcinomatous involvement. The enlargement was due chiefly to endothelial proliferation.

That these glands were not carcinomatous, notwithstanding the fact that this was a recurrent tumor, would, in itself, have been very strong presumptive evidence that the tumor was not an ordinary carcinoma. Plate IV represents one microscopic field of this tumor. You will see at once how very different it is from any of the carcinomata of the breast which are described by the authors. Please observe that the tumor is made up chiefly of very large tubes which are lined with epithelium many cells deep.

In some of the tubes these epithelial cells might seem, at first sight, to be disposed without attempt at arrangement, but a second glance discovers cell combinations which have resulted in the formation of gland-like figures, circles, and tubes, and columns, and minute papillæ. The cells are often so snugly fitted together in these heavily-lined tubes (or heavy tubes) as to conceal the original figures; but almost always, even when the tubes are completely filled with tightly packed cells, one can detect little circles of cells or little tubes which betray the tendency and the ability which the cells still have to form definite combinations (see Plate I.). Sometimes columns and circles anastomose in such a way as to form a mesh of more or less open network when there is room enough for such figures.

In certain parts this tumor has become pure carcinoma and has lost its adenomatous type; the epithelial cells, having lost their power to form combinations, lie irregularly and closely packed together in lymph-spaces.

Last September this patient wrote us that she was perfectly well, and that she was unable to detect any sign of a local recurrence of the tumor.

Sometimes the carcinoma and this peculiar adenoma, with its large heavily-lined tubes, seem to be growing side by side and independently, the carcinoma infiltrating the stroma, we might say, of the adenoma and suggesting, for the moment, a bitypic form of tumor. This bitypic form of growth characterized certain parts of the tumor in the following case:

Case II. *Malignant adenoma* (*adenocarcinoma*). Surg. No. 3175; Path. No. 511. Mrs. Mary P., colored, aged fifty years. Admitted June 14, 1894, with a large fungating mass, measuring 12 cm. by 14 cm., in the upper and outer quadrant of the left breast (see Plate II., *a* and *b*). Three years before admission patient first noticed a small nodule in this breast which has been growing steadily and painlessly ever since. For nearly two years the skin remained intact. Since September, 1893, nine months prior to admission, there have been frequent hemorrhages from the surface of the growth, caused, probably, by the sticking of the dressings. A thin, sanious, foul-smelling fluid constantly exudes from the surface of the mass. The edges of the tumor

overhang the skin for about 1 to 2 cm. on all sides. There was evidence of cancerous involvement of the neck of the uterus; nevertheless a complete breast operation was performed. The prognosis, so far as local recurrence was concerned, was unusually favorable: the axilla was not involved; the enlarged lymphatic glands showed endothelial hyperplasia.

When we state that an axilla is not involved we mean that every gland and all of the fat having been exhaustively examined with the microscope, no evidence of cancer has been discovered.

The microscope, as I have said, revealed this association of the heavily lined, very large tubules in which the epithelial cells have preserved their ability to make more or less definite cell-combinations, and the small cancer alveoli occupying bitypically, as it were, the stroma of the adenoma. In other tumors and in other parts of this tumor one can see what would be called the transitions in all the desired forms, from the heavy tubes lined with cells in definite combinations to the finest lymph spaces containing three or four epithelial cells without arrangement. We are often able to trace, even in the metastases of the purer carcinomata, indications of a tendency in the cancer cells to form combinations which recall the gland structure. This patient died of the cancer of the uterus, two and one-half years after the breast operation. There was no recurrence of the breast tumor.

The following case does not strictly belong to this group. I introduce it because it presents in places a type of tumor which might, for the present, be regarded as transitional to the adenocarcinomata to which I have invited your attention.

Case III. *Scirrhous carcinoma and intracanalicular papillary adenocarcinoma (duct cancer).* Surg. No. 6059; Path. No. 1611. Mrs. J. M. S., white, aged sixty-one years. Admitted November 30, 1896. Carcinoma of right breast, axilla, and supraclavicular glands. Metastasis in left femur, followed by fracture. Probable local recurrence near sternal edge of scar.

Patient did not suspect that she had a tumor until February, 1896. An increase in the size of the affected breast called her attention to it.

She then examined it for the first time, and discovered a hard mass in the neighborhood of the nipple to which the skin was already adherent. She soon began to notice occasional stabbing pains, but otherwise experienced no discomfort from the new growth, which, instead of growing larger, steadily decreased in size from the time when she first discovered it until she came to the hospital. No fluid had ever escaped from the nipple.

On admission, the nipple was tilted upward; the eye detected no tumor in breast, axilla, or neck. The skin covering the breast was not ulcerated, but it was adherent to an underlying mass which could be felt surrounding the nipple. No fluid could be expressed from the nipple. Chart No. 1611 (not here reproduced), which Dr. Cushing kindly painted for me from the fresh specimen, shows the appearance of a section through the nipple and centre of the breast. A number of minute cysts were encountered in this section; two of them, larger than the others, are accurately represented in the colored chart. The largest of these two cysts measured 1 cm. in diameter, and was almost filled by a little pedunculated ingrowth. The smaller cyst also contained a minute papilloma. Both of these larger cysts and some of the smaller ones scattered throughout the breast contained a dark and almost black fluid. Minute cysts in other parts of the gland were filled, some with a reddish-brown, some with amber-colored fluid, and some with contents resembling milk, or pus, or cheese. The smallest of these cysts formed hard shot-like bodies in the breast, which can sometimes be diagnosticated by palpation through the skin.

A diffuse scirrhous growth, about 3 cm. by 3 cm., in which the larger and many small cysts were embedded, occupied about the centre of the breast and involved the overlying skin and the nipple. It was impossible with the naked eye to determine the limits of this cancer. Dr. Cushing succeeded in cutting and mounting a section of this tumor, which shows the tissues surrounding the cyst, the wall of the cyst, the pedunculated growth, and even the pedicle of the papilloma; and Dr. Hugh H. Young made for me the wall-chart, which represents so beautifully the microscopic appearances. Plate V. drawn by Becker, is a faithful interpretation of the same section. The pedunculated ingrowth is not one of the ordinary varieties of benign

intracanalicular papilloma. It has very little stroma; just enough, perhaps, to support the parenchyma. It is chiefly parenchyma, and the epithelial cells form, apparently, combinations similar to those which we have described in the previous two cases—combinations which result in the formation of the large heavily-lined tubes. The pedicle is very delicate, transmitting a few vessels, but consisting chiefly of epithelium many rows deep on the surface, and exhibiting the tendency wherever feasible to form the heavy tubular combinations referred to. In the wall of the cyst, but one or two millimetres from its lining, we meet carcinoma in which the cells have lost their power to form glandular combinations, and appear as ordinary cancer cells incapable of further differentiation. In the glands of the axilla and in the neck were found metastases, most of them undifferentiated cancerous metastases, but some of them revealing the glandular type. This patient died one year after the operation, with metastases.

The above case is a true scirrhous cancer, starting probably in the wall of a cyst, and should not be classed with the other five adenocarcinomata; but in Plate V.. you will observe that the cancer (*c. c. c.*) surrounds a little field of intracanalicular papillomatous adenocarcinoma (the villous carcinoma of Cornil and Ranvier, and the duct cancer of the English surgeons), which recalls in places certain pictures which are familiar ones in the other five adenocarcinomata. Large, heavy tubes there are, two or three of them, which resemble the heavy tubes of the other tumors, but are not precisely like them. There seems to be no tendency in the tubes of the duct cancer to form the rings and other cell-combinations which characterize the other five adenocarcinomata; and there is in this miniature duct cancer, as in all duct cancers, a very conspicuous tendency to produce intracystic villous growths (see Plate V.).

Case IV. *Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 123; Surg. No. 2337. Mrs. M. P., white, aged sixty-five years. Admitted July 7, 1893. Eleven months before admission patient had noticed a tumor the size of a "walnut" in her left breast. On admission this tumor in the upper and outer quadrant measures 4 x 3 x 3

cm. It is not adherent to the skin or muscle, and the nipple is not in the least retracted. The complete operation below the clavicle was performed by Dr. Finney. In a note on the macroscopic appearance of a section through the middle of the tumor, Dr. Bloodgood emphasizes the fact that, on pressure of the tumor, a number of long, very fine, soft cylinders were extruded from the cut surface. These were, probably, the partially necrotic centres of the large tubes which I have described.

This was our first case of this variety of tumor. The axillary glands show endothelial hyperplasia, but no metastases. The tumor was a malignant adenoma of precisely the same variety as those already described; but the type had remained pure, there being no areas of pure carcinoma and no transitional pictures. We had a letter from this patient a few days ago (April, 1898), stating that she was perfectly well, and that, so far as she knows, there is no evidence of local recurrence and none of metastases.

Case V. *Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 204; Surg. No. 2565. Mrs. S. G., white, aged sixty years. Admitted October 18, 1893. Patient stated that five years before admission to the hospital she bruised the right breast badly; three months thereafter she noticed a small lump in this breast, which four years later became adherent to the skin. When operated upon the tumor measured 4 x 4 x 3 cm.; it occupied the upper part of the upper and outer quadrant of the breast, over the sternal origin of the pectoralis major muscle. It was adherent to the discolored skin and apparently to the pectoral fascia. Plate III., although not a good one, shows at least that the growth was exuberant and would soon have become fungating. At the operation the prognosis was considered favorable, except for the fact that the muscle over the sternal ends of the second, third, and fourth ribs was infiltrated. It was, however, possible to give the local growth a fairly wide berth.

Microscopical examination. The tumor involved both skin and muscle, but there was no evidence of metastatic involvement of the muscle or other tissue. The axillary glands were enlarged (endothelial hyperplasia), but metastases have not been found in them.

April 1, 1898, four years and six months after the operation, this patient was examined by Dr. Bloodgood, who reported a

perfect result; free use and no swelling of the arm, no sign of recurrence or metastases, and excellent health of patient.

Case VI. *Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 994; Surg. No. 4420. E. M., white, single, aged forty-two years. Admitted to the hospital July 15, 1895. One grandparent, one uncle, and one sister died of cancer; the sister with cancer of the breast. Scattered through the breasts are small hard nodules, from 3 to 5 cm. in diameter; in the left breast, the lower and inner quadrant, is a nodule which is harder and more tender than the rest, and which the patient has noticed for about three months only. This nodule measures about 2 x 3 cm. and is freely movable. The skin over the breasts is everywhere normal. The nipples are not retracted. The axillary and inguinal glands on both sides are sufficiently enlarged to be easily felt. July 17, 1895, the complete infra- and supraclavicular operations were performed by Dr. Bloodgood.

The suspected tumor occupied the sternal border of the lower and inner quadrant of the breast; it was very hard and irregular in outline, not circumscribed, everywhere surrounded by breast tissue; on section it cupped, and from the cut surface, on which could be seen little yellow dots and lines, there could be expressed a soft, rather granular material. The breast tissue on the confines of the tumor differed in appearance from the rest of the gland, being pink in color instead of pearly-white, and studded with minute hemorrhagic points. Between the nipple and this tumor is a second tumor resembling those found elsewhere in the same breast. On section this little tumor, 1 cm. in diameter, instead of cupping, becomes elevated about 2 cm. above the surrounding tissue; it is lobulated, and nothing can be expressed from its cut surface. Between this second tumor and the first there are smaller lobulated nodules resembling the main tumor in that a few minute areas of necrosis can be seen and partly expressed. Throughout the breast tissue, both outside of and within the nodules, are little cysts which are brownish in color and contain a clear fluid.

Microscopic examination. The principal tumor is an adenocarcinoma of the large, heavy-walled cylinder type which we are considering. The axillary glands, macroscopically large and soft and somewhat hemorrhagic, contained no metastases. This patient was heard from a few days ago (April, 1898). She reports herself perfectly well, with no sign of recurrence of the tumor, three years and nine months since the operation.

In each one of these five cases we have an adenocarcinoma of a type so distinct that we may advantageously consider them, for the present at least, as constituting a more or less specific class. In Cases IV. (123), V. (204), and VI. (994) we have this adenoma pure throughout the neoplasm; Case VI. was operated upon nearly three years ago, Cases IV. and V. nearly five years ago. Within the last three weeks they have all reported themselves as perfectly well and without a sign of return of the disease. In Case I. (1705) the change from the adenocarcinoma to the purer carcinoma is apparently just beginning to take place in certain parts of the tumor, but the axillary glands, although much enlarged from endothelial hyperplasia, show no involvement. This patient is also living without doubt; we heard from her last September in reply to our last letter.

In Case II. (511) this same adenoma and the carcinoma were growing side by side in many parts in the bitypic manner already described, and still the axilla was not involved. This patient had a cancer of the uterus when we operated upon her breast. If the uterine tumor had been operable this patient might still be living.

The five cases of adenocarcinoma which we have very briefly considered this morning resemble in certain respects, and in other respects differ from, the so-called duct cancers. The duct cancers hitherto described have been small tumors, for the most part circumscribed, and resembled sarcomata; macroscopically as well as microscopically the villous nature of the tumor has always been conspicuous. That they bulge on section is frequently noted in the descriptions of these duct cancers; and by most they are said to be soft, very friable, and difficult to cut.

The adenocarcinomata which I have described resembled on section the carcinomata and not the sarcomata; a villous or papillomatous tendency was never apparent and not even suspected from the gross appearances of the freshly cut surfaces. Fine worm-like cylinders of epithelium could be expressed from some of these tumors, but not from all. All of these new growths infiltrated the surrounding tissues just as carcinoma does. With the microscope the power of the epithelium to

make ring-like combinations, as shown in the drawings, was very conspicuous, whereas the tendency to form villous growths was not so evident.

I must not weary you further by describing the finer structure of these tumors. The histological details are reproduced with most gratifying truthfulness in the plates; and, when a sufficiently high power has been employed, each nucleus has been copied as faithfully as possible.

It is possible that the relations of these growths to the lymphatics and bloodvessels is such as to render difficult the entrance of the cells into the circulation.

We have, I think, said enough about these adenocarcinomata to make it clear that they have striking clinical and histological features in common; but we shall not succeed in drawing a very sharp line between this particular variety of adenocarcinoma and certain other adenocarcinomata in our collection. Some of the latter resemble the two cases described by Billroth as cysto-adenomata; others, the thyroid gland. In one case the resembance to the thyroid gland was remarkable.

It is quite likely that some of the little tumors which have been described as duct cancers are early stages of these adenocarcinomata.

We have several times met with just such cases as No. 111—a cyst or cysts with intracystic papillomata, and scirrhous cancer at the base of the villous growth.

[The writer then described with some detail the cancer cysts, of which he had seen six. He emphasized the fact that the cancerous walls of these cysts may be very little thicker than the wall of an ordinary retention cyst of the breast, and that the surgeon who was not aware of the existence of these cancer cysts, or to whom the appearance of the wall was unfamiliar, would almost surely regard them as innocent; for the cancerous wall of these cysts is often not much thicker than the wall of a benign cyst, and usually is, at least, too thin to show the well-recognized cancer markings. For years it has been the writer's custom to demonstrate what he calls a cancer edge. The edge is made

with a sharp knife by two cuts at right angles to each other. This edge becomes rounded on handling, but does not fray out as an edge in pure connective tissue would do; and does not squeeze down as it would if inflammatory products contributed to its support. When the cancer is young, or if it is rapidly growing, there is a certain translucency which assists the diagnostician. It is, of course, only when the growth is very small indeed that these aids to diagnosis are required. When the neoplasm is a few lines thick the diagnosis, at least so far as malignancy is concerned, is usually not difficult even for the novice.]

Our present method of operating for the cure of breast cancer is even more radical than it was at the time of the writer's first publication on this subject. The supraclavicular region is almost invariably cleaned out. To do this we no longer divide the clavicle as we did five or six years ago; for simple division of the clavicle does not facilitate the dissection much, if any, and the removal of a piece of the collar-bone is a procedure which maims without sufficient compensation. If it were very desirable to remove the supraclavicular contents in one piece with the axillary contents and the breast, one might not hesitate to excise, if necessary, even the entire clavicle; but the removal of the supraclavicular fat and lymphatics is best done from within outward and from below upward, for in cleaning large veins like the subclavian and internal jugular the surgeon works to the best advantage if he starts at the vein and works away from it. The subclavian vein being the starting-point in the dissection of both the infra- and supraclavicular regions, it is unnecessary to remove the clavicle and useless to divide it. By elevating the shoulder the clavicle can be raised an inch or more away from the first rib when the operation is so far completed as to make this desirable. The web of fibrous tissue which binds the subclavian vein loosely to the clavicle is thus spread out, and can be easily removed. The fingers can be passed from the supra- to the infraclavicular and to the subscapular regions under the clavicle, and any fat in the latter region, near the internal or the posterior

border of the scapula between serratus magnus and subscapular muscles, which could not be reached from the axilla can be drawn out through the neck. Dr. Bloodgood, my former house-surgeon, was, I believe, the first to demonstrate the advantages of completing the cleaning out of this postero-internal subscapular region by the supraclavicular route. To excise the supraclavicular tissues we use a vertical incision parallel with the sterno-cleido-mastoid muscle near its posterior border; a few of the posterior fibres of this muscle are divided and the junction of the internal jugular and subclavian veins is exposed. At the angle of junction of these veins the dissection is begun. The omo-hyoid is divided at its tendinous part, the two bellies of this muscle being drawn out of the way and serving, in a measure, as retractors.

We have cleaned out the supraclavicular fossa in 67 cases. Cancer was found in the tissues removed 23 times, or in 34 per cent. of these cases. In 30 cases there was no cancer, and in 14 it is still uncertain whether the supraclavicular region was involved or not, because the tissues have not yet been exhaustively studied. Only those familiar with the work can understand the amount of labor implied in the statement that a given mass of the fat does not contain a cancer alveolus.

Not all of the 67 operations above the clavicle were what we call primary, for 14 of them were performed subsequent to the original operation and because supraclavicular glands could be palpated. Living and apparently free from metastases three or more years after the primary operation are four cases whose necks were involved and cleaned out secondarily. Of these, two are living and well more than four years after the primary operation, and three and three and a half years respectively after the operation on the neck. In one of these latter cases I considered the prognosis desperately bad at both the infra- and supraclavicular operations. At the first operation the cancer had infiltrated the axillary fat diffusely, and could with difficulty be separated from the subclavian vein; at the second operation the same desperate state of affairs was encountered in the neck. A piece of the clavicle was exsected and a very

thorough operation performed. We were pleased to find at the second operation that there was no evidence of recurrence in the axilla. It is now more than three years since the neck operation was done, and the patient, whom I saw a few days ago, feels perfectly well, and has no signs of recurrence or metastases.

When these statistics were prepared the neck operation, as we call it, had been performed primarily 53 times; in 12 of these cases, about 23 per cent., the supraclavicular tissues were involved.

It is to be hoped that others have reached the conclusion that we should not abandon as hopeless all cases of breast cancer in which there is supraclavicular involvement. Indeed, I fail to see why the neck involvement in itself is more serious than the axillary. The neck can be cleaned out just as thoroughly as the axilla. Dr. Bloodgood, Instructor in Surgery, has, on the necks of two patients, done as many as three operations, each for glandular involvement, and apparently saved his patients. The additional operations were for glands above and below the region of the neck first attacked. In one of these cases he sutured the mediastinum from above to remove a cancerous gland, and had to excise a piece of the innominate vein. Dr. H. W. Cushing, my house-surgeon, has in three instances cleaned out the anterior mediastinum on one side for recurrent cancer. It is likely, I think, that we shall in the near future remove the mediastinal contents at some of our primary operations.

As I have said, we clean out or strip the supraclavicular fossa with very few exceptions at the primary operation. It would be unwise, I think, to postpone this operation until enlarged glands can be palpated above the clavicle, for we not infrequently find in the tissues removed cancerous glands too small or too deeply imbedded in fat to have been felt through the skin, and often a large gland or several glands at the junction of the subclavian and internal jugular veins which were too deeply buried behind the clavicle to have been detected before the operation. The axilla offers no criterion from which we might

draw inferences as to the condition of the supraclavicular fossa. Sometimes, with an axilla which is involved chiefly in the lower or arm part, and apparently not at all in the upper or subclavian part, we have a neck involved solely at the junction of the internal jugular and subclavian veins. This state of things was present in a recent case in which I had a considerable personal interest. The patient was a young lady whom I was very loath to disfigure, and as the higher or subclavian part of the axilla seemed free from cancer, and nothing suggestive of cancer could be detected in the neck, I said to my assistants that I would not touch the neck. But upon examining the breast and axillary contents removed, I was so much impressed with the unusual malignancy of the little cancer that I returned to the table and stripped the supraclavicular fossa. Several cancerous glands were found at the junction of the great veins and internal to the inferior thyroid artery.

It sometimes happens, on the other hand, that the neck is not involved although the axilla is a solid mass of cancer. Hence, it would appear that for the present our rule should be, *operate on the neck in every case.* The neck operation should not be postponed for a second act. It can never again be done so well as at the first operation, when the axilla is open, the subclavian vein fully exposed, and the clavicle free. In the main operation we have made some changes. We remove the minor as well as the major pectoral muscle, dividing the insertion of the major and then its origin and the origin of the minor, before we expose the subclavian vein. This vein is first exposed at its inner part, and the axilla stripped of its contents and its anterior wall at one time from within outward and from above downward as heretofore. We have made no change in the skin incision; indeed, I should hardly know how to do so; one must always circumscribe the mass to be excised with a circular or an oval incision, and must make additional cuts to expose axillary and jugular veins. Tumors should never be harpooned, nor should pieces ever be excised from malignant tumors for diagnostic purpose. Think of the danger of rapid dissemination of the growth from injecting cancer of the tongue

with cocaine and then snipping off a piece of the tumor with scissors.

In studying the published histories of cases of malignant tumors, particularly sarcoma, I have been impressed with the great number of cases in which general dissemination of the neoplasm has seemed to follow swiftly upon exploratory incisions.

Breast tumors should not be incised on the operating-table prior to their removal. The surgeon must learn to recognize malignant tumors not only with the microscope, but also with his naked eye and fingers.

There are, of course, tumors which cannot be diagnosticated until an incision has been made into them or into the axilla. For example, a large benign cyst may have a tiny cancerous spot in its wall, or a very slowly growing carcinoma may be sharply defined or even encapsulated and resemble on palpation a benign tumor. If the surgeon cannot, in a given case, make a diagnosis prior to operation, an exploration of the axilla might help him; if still in doubt, he should excise the breast or, at least, give the tumor a wide berth. If then, on incision, the tumor proved to be malignant, the complete operation should be performed immediately.

Operating for the cure of cancer is a very great labor. We never attempt more breast cancers than one in a day. The operation, including the toilet of the wound and the grafting, requires from two to four hours with highly trained and skilful assistants; it is performed in an absolutely bloodless manner, and the patient, in consequence, suffers not at all from shock. Three days ago, for example, in a three-hour operation, the patient's pulse ranged from 66 to 70 throughout the entire operation. At all operations a record of the pulse is kept on what we call the *ether chart*, introduced by my house-surgeon, Dr. Cushing. We remove rather more skin than we did originally, and in all cases we graft the wound immediately. Grafts are cut from the patient's thigh as large as or larger than one's hand. A single one of these large grafts may be enough to cover the raw surface. In cutting a graft of this kind the skin is made tense by a board which the operator slides along the thigh just

in front of a large amputating knife or catlin. The graft is spread, raw side up, on a piece of rubber tissue, and from the latter is readily transferred to the breast wound. It is finally covered with silver foil and tissue paper, and need not be looked at again for two or more weeks. The silver foil makes an ideal dressing for grafts, very much better than anything else we know of. For several years we hesitated to graft these cases at once, fearing to prolong the operation another half-hour; but now we have become accustomed to these very long operations, and have learned that they may safely be continued almost indefinitely if they are bloodless and if the anæsthetic is properly given.

Results of Operations for Breast Cancer at the Johns Hopkins Hospital from June, 1889, *to April*, 1898.

During the past two years my assistants, Drs. Finney, Bloodgood, and Cushing, have probably performed the majority of the breast operations; prior to this, almost all of the breast cancers were operated upon by the writer. One hundred and thirty-three cases have been operated upon; seventy-six of these more than three years ago. There have been thirteen (9 per cent.) local and twenty-two (16 per cent.) regionary recurrences. Of the seventy-six cases operated upon three or more years ago, thirty-one (41 per cent.) are living without local recurrence or signs of metastases; ten died more than three years after the operation, and one as late as five and a half years thereafter; of these ten, one had a local recurrence. Forty cases, therefore, (52 per cent.) lived more than three years without signs of local or regionary recurrence. Some of the ten cases which died may have had at three years signs of metastases; I cannot make a positive statement as to this point. Thirty-five cases (46 per cent.) died within three years of the operation, and seven of these with local recurrence.

PLATE I.

Recurrent Adenocarcinoma of the Breast.
Patholog. No. 1705.

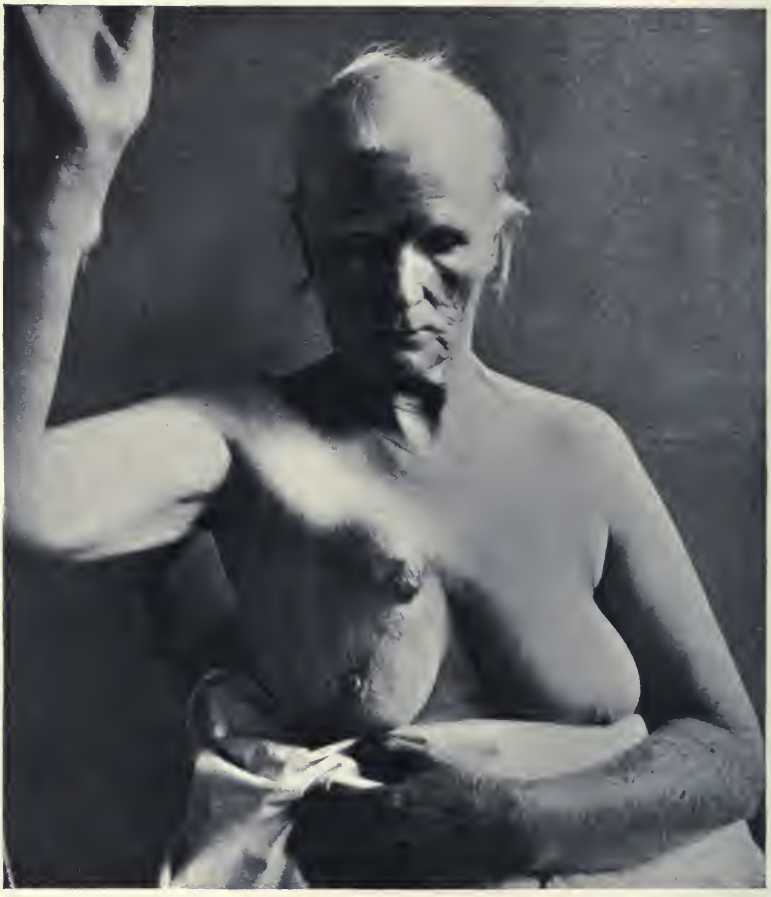
PLATE II.

A

B

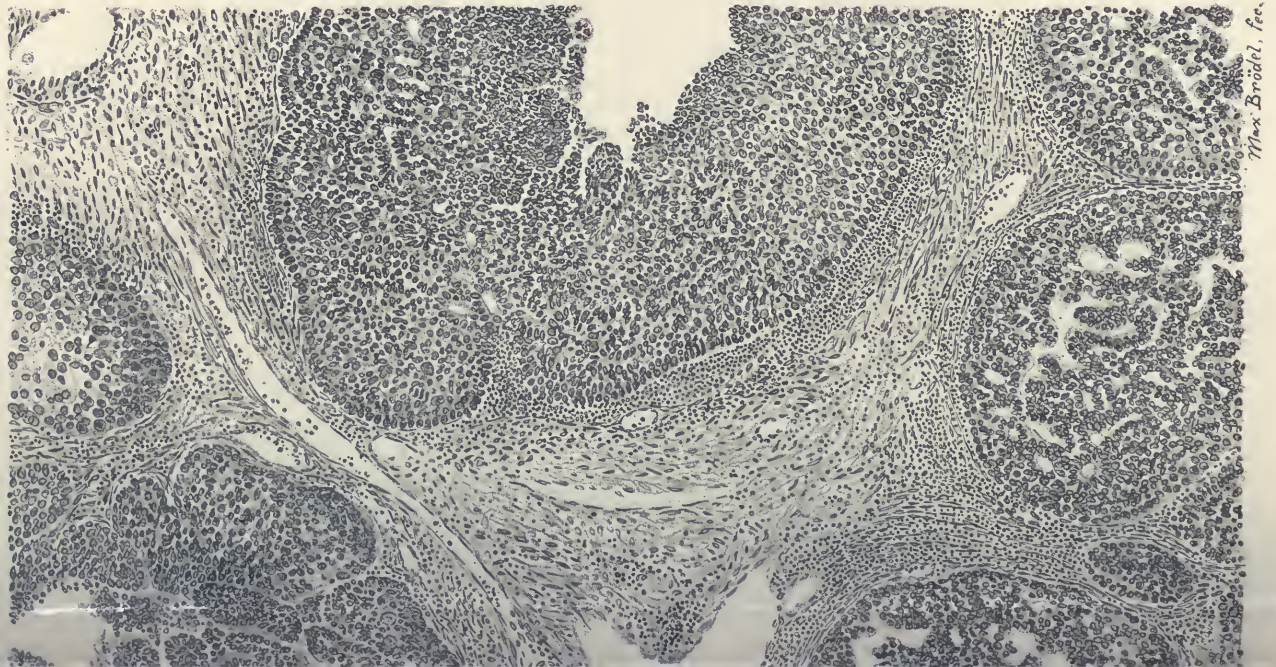
Adenocarcinoma of the Breast. Patholog. No. 511.

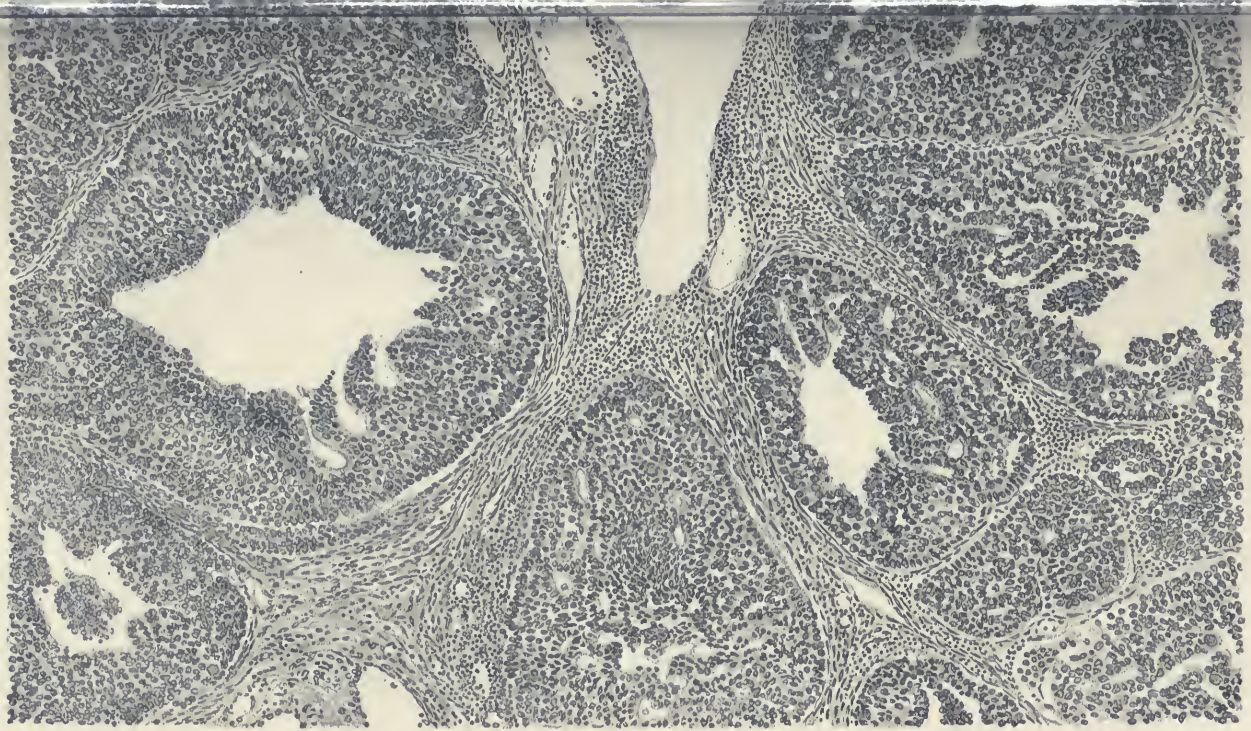
PLATE III.



Adenocarcinoma of the Breast. Patholog. No. 204.

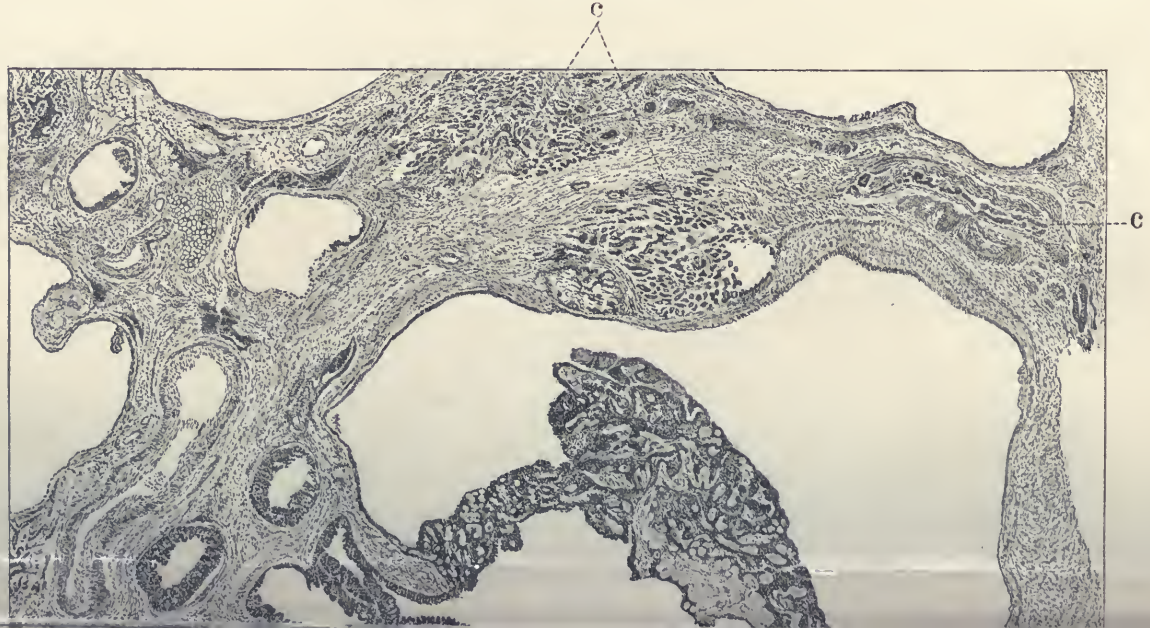
PLATE IV.

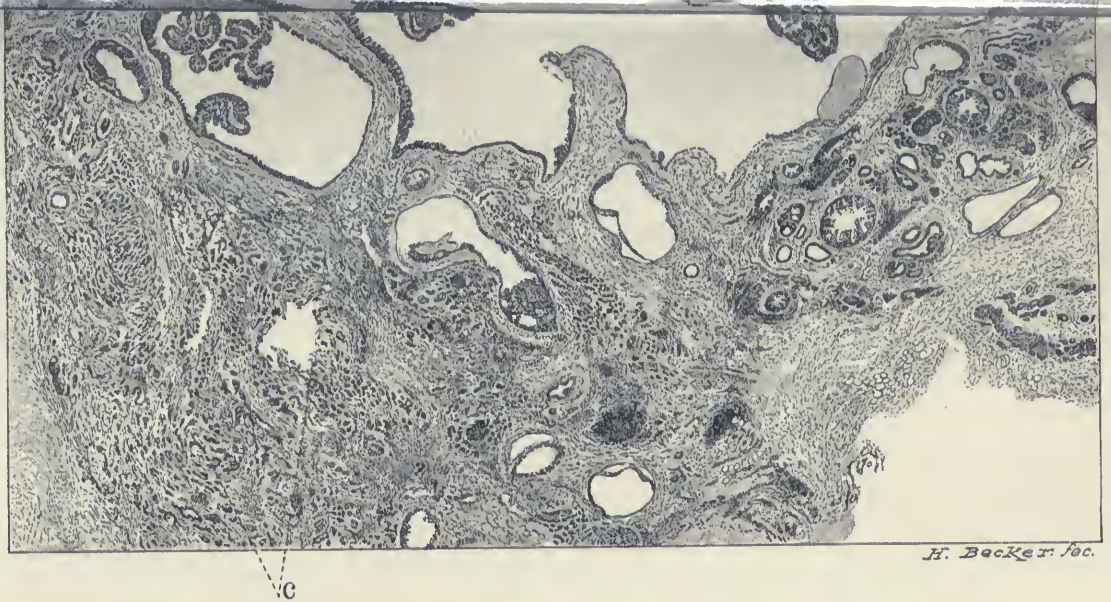




Adenocarcinoma of the Breast. Patholog. No. 1705.

PLATE V.





Carcinoma of the Breast, c, c, c, and Intracanalicular Papillary Adenocarcinoma. Patholog. No. 1611.

DISCUSSION.

Dr. Frederic H. Gerrish, of Portland, Maine.

It was with much misgiving that I accepted the invitation of the Committee on Scientific Programme to take part in the discussion of the paper to which we have just listened. Distrust in my ability to do justice to the subject increased steadily the more I contemplated the task which I had accepted, and now culminates in a conviction of incompetency. Nobody can be a just and thorough critic unless he knows substantially as much about the subject under consideration as does the person whose work he reviews. My sole consolation in the premises is the belief that some of those present would deserve to be no more comfortable in the situation than I am. How few, indeed, can show such a record of work—clinical, operative, pathologic—as has just been displayed! In fact, has anybody anywhere anything which goes as far in all directions of mammary investigation? And this question is put with no thought of ignoring or disparaging the admirable work of some others.

Time was when any practitioner who used the knife at all felt himself competent to remove the breast. Mammectomy was one of the few procedures of considerable magnitude with which a novice was justified in beginning his operative career. A recent text-book on surgery—an unusually good one in the main—contains nothing on the diseases of the breast, the author excusing their absence by saying that the book was crowded without them, and implying that these affections are so easy to diagnosticate and so simple to treat that their omission is of little consequence. If he had said that none but an expert should undertake the operation for the removal of breast tumors he would have given a fairly good reason for leaving out a description of it; but every practitioner ought to have far more advanced views than most possess concerning their diagnosis and necessity for prompt surgical interference.

It is interesting to trace the steps by which the operation has reached its present position. An elliptical incision of the skin, just clearing the areola, the dissecting back of the flaps, the removal of the manifestly diseased portion of the gland, and the closure of the wound—that was the operation which many of us remember. Then the ablation of the entire mamma was insisted upon as essential. Next

the careful removal of the fascia of the pectoralis major was advocated. The sacrifice of skin of the entire breast was then found necessary. The clearing out of the axilla in every case, whether or not enlargement of the nodes could be detected before operation, was a great advance, as also was the avoidance of wounding the lymph-vessels between the breast and the axillary nodes. Finally came the extensive dissection of every region containing nodes which could be infected by the absorption of cancerous poison from the original focus of disease, and we now have an operation which should be regarded as unjustifiable for the general practitioner, since it demands the anatomical knowledge, the trained hand, and the steady nerves of the expert, I had almost said of the specialist.

For a long time we have known something of the remarkable work of Dr. Halsted in this line, and the announcement with which his name is connected in our programme was sufficient to excite lively anticipation of new and valuable revelations. Our expectations have been in no wise disappointed. We have learned of the differentiations of morbid growths which we have previously considered to be of a single kind; we have been informed of the relative malignancy of the different varieties of mammary carcinomata—a very important point in prognosis; we have had our attention called anew and most emphatically to the necessity of the removal of the lymph-nodes of clavicular region; the proper operation has been described, and the results, extending over almost a decade, have been collated and tabulated for our instruction.

In the time which I may properly occupy I can offer only brief comments upon a few points, which seem to me of most practical importance.

1. The necessity of the removal of all mammary tumors. That some benign growths never degenerate is true; but nobody can predict with certainty which these are, and, therefore, all should be condemned.

2. Thoroughness of operation. Doubtless life may be prolonged by the ablation of the breast alone; but extirpation of the disease can be looked for only when all of the related lymph-vessels and nodes have been removed. This, of course, involves extensive dissection and consumes much time; and we are warranted in believing that the operation has been very imperfectly performed when the surgeon complacently remarks that but a quarter of an hour was occupied in the entire procedure, even to the last stitch.

3. The hopefulness of prognosis as compared with former despair. I have heard noted members of this Association declare that a cancer patient will sooner or later die of cancer, whatever operation is done, unless she is fortunate enough to be killed by some intercurrent malady. One surgeon of prominence has pronounced operations for cancer to be utterly useless. In Dr. Halsted's series are included cases once regarded as absolutely unfit for operation, and even in these life has been prolonged by surgical interference and rendered much more comfortable. Best of all, in some very serious cases the disease has not returned after the lapse of years.

The distinguished author of this paper deserves and has our grateful acknowledgments for the brilliant light which he has thrown upon these dark places of surgery.

Personal Experience, with Remarks on the Operative Treatment of Cancer of the Breast.

By Dr. Rudolph Matas, of New Orleans.

When, in 1886, I visited Paris and gazed with admiration and amazement at the vast distribution and unsuspected resources of the peripheral lymphatic network as displayed with startling effect by the hand of that consummate anatomist, Prof. Sappey, I was particularly struck by the preparations of the mammary region and of the uterus. I then realized, as never before, the reasons for the obstinate regional recurrences, the early dissemination and general metastases of the malignant neoplasms when they primarily invade these regions. I then understood more clearly the reasons for the failure of surgery in this field and the pessimistic views held on the subject by the vast majority of the surgeons of the day. I then simply wondered that any of these patients ever recovered, and that operations, as they were then generally performed, sometimes did succeed in eradicating the evil. But discouraging as they appeared, these injections and dissections of Sappey went far toward encouraging the hope of cure by surgical intervention. For, while they showed that the avenues of infection from the mamma and the skin, and thence to the axilla, were extraordinarily free and easy, they suggested the possibility of eradication by the total extirpation of the gland with its overlying skin and the axillary contents, which were their main, if not exclusive, terminus. Another point in the lymphatic distribution of the mamma appeared also to

have been made clear by Sappey (and before him by Sorgius), which was exceedingly favorable to radical treatment, and that was, that the lymphatic currents were directed throughout from the base to the apex and toward the nipple. According to this understanding, the retro-mammary region was not directly connected with the gland, and no fear of contamination with metastatic emboli had to be apprehended in this quarter, provided the retro-mammary space had not been primarily involved in the neoplasm.

According to Sappey, all the lymphatics of the gland itself ascend and converge to the nipple, where they form large trunks on the anterior aspect of the mamma, whence they travel upward and empty themselves into the axillary lymphatics. But, unfortunately for this view, the careful injections and histological studies of Mascagni and Langhans, subsequently confirmed by Poirier, Rieffel, Gussenbauer, Küster, Heidenhain, Stiles, Jœrss, et al., abundantly prove that Sappey's teachings were only partially true, and that the avenues for the dissemination of the cancerous emboli are indeed far greater than he or his followers suspected. In fact, according to the observers referred to, the anastomoses and connections between the retromammary network and the intraglandular lymph plexus are so free and intimate that the entire lymph-carrying system of the thoracic parietes, including the mediastinal nodes, is apparently at the mercy of any malignant neoplasm that may be lodged in the parenchyma of the breast. One thing we have also learned by these recent researches, and that is, that the entire axillary, subscapular, and deep cervical groups may be infected primarily through the deep submammary lymph canals that lie *in* and *under* the pectoral fascia, independently of the great highways of the lymph currents that overlie the gland under the skin. So that, contrary to older teaching, nothing like a thorough eradication of the lymph tracts from the breast to the axilla can be contemplated, at least in deep glandular growths, without a total excision of the retro- and paramammary connective tissue, including in this the whole suspensory apparatus of the gland, the pectoral fascia, and at least the sternal portion of the pectoralis major muscle. All of which has been so thoroughly understood since Volkmann, Küster, Halsted, Meyer, Watson Cheyne, Helferich, Rotter, and other recent writers have described their methods and experiences that it would be superfluous to insist upon them on this occasion. But the point that I would dwell upon is that while modern

methods of histological and pathological research have improved, and as we have gained a clearer and broader insight into the mechanism of cancerous dissemination, the difficulties in the way of surgical relief have also increased, so that the purely technical problems that confront the conscientious operator who would be radical in his intervention have assumed far graver, more complex, if not more uncertain phases.

Thus far, the greatest bar in the way of the successful surgical treatment of cancer of the breast, as of other localities, lies in the inability of the operator to adequately estimate the full extent of the lymphatic involvement in the epithelial growths and of the internal metastases especially in cases of sarcomatous infection. It is in the utter impossibility of recognizing the microscopic and *impalpable* contamination of the lymph tracts that always precedes the gross and *palpable* evidences of migration and metastasis that is the chief and essential cause of uncertainty as to the final outcome of nearly every operation that is performed for this condition. The older surgery failed almost totally in its curative efforts chiefly because it disregarded the wide local and regional distribution of the migratory cells in the lymphatic network. At first, the timid, partial operations ruled the day, and their inevitable failure led to the total amputation of the gland. As this also failed, the axilla was invaded and only *visibly* diseased lymphatics were removed. Then the truth gradually dawned upon the operation that the simple removal of visibly contaminated tissues was often insufficient, because beyond the area that was greatly diseased there was, as a rule, another zone which was almost certain to develop new centres of malignant recrudescence. It was this fundamental idea, coupled with the greater security given by asepsis, that led to the establishment of the surgical maxim that few operations for well-developed cancer can be considered radical unless the removal of the primary growth is accompanied by the *prophylactic* extirpation of its tributary lymphatic areas. Thus it is that prophylactic extirpation constitutes the keynote to the more aggressive procedures which are to-day designated as "complete" or "radical," and which, beginning with the operations of Moore (1867), Gross (1880), Volkmann, Gussenbauer, Küster, Banks, have found their most exalted expression in the present and now well-known methods of Halsted (1894), Meyer, Lane, Cheyne, Rotter, Helferich, and others. But, as our knowledge of what constitutes the tributary lymphatic areas

has expanded, we find that the strict application of the principle of *prophylactic* extirpation has become more difficult, if not practically impossible to realize in practice.

For example, if we admit that the migratory germ cells from a carcinoma of the breast must be carried along the path of the lymph current until their progress is temporarily arrested by the first lymph nodes that lie in their way, then, it is plain, in view of our present knowledge of the location of these outposts of the lymphatic system, that we would have to include in our preventive extirpation not only the axillary, the infraclavicular and subscapular groups, but also the retrosternal, anterior mediastinal, deep cervical, intercostal and post-mediastinal groups, with their intervening lymph channels as well. This last provision is not only necessary, because we now know that there is a direct connection between the intramammary lymph network and all the aforesaid groups, but because it is clearly proved by recent histological investigations that the lymph channels themselves are frequently plugged with cancerous emboli long before they reach the terminal lymph nodes. But if we were to follow this principle of prophylactic extirpation to its legitimate and logical conclusions we would be compelled to control part of the vascular (venous) channels which drain the region, as these are just as likely to serve as avenues of dissemination as the lymph tracts. The impracticability of such a proposition is so grossly apparent that it would be absurd even to refer to it were it not that it demonstrates how imperfect and limited are our surgical resources to cope with this illusive and far-reaching evil. These considerations also make it clearly apparent that surgical intervention in cancer of the breast, as well as in other localities, must always remain a tentative or, at least, an empirical procedure in the vast majority of cases as they present themselves to us in practice. Operations may be more or less aggressive, more or less complete as regards the thoroughness with which the diseased breast, its adnexa, and the extra-thoracic lymph tracts, are removed, but in the strictly anatomical and surgical sense the operation is bound to be imperfect and incomplete.

In other words, even in the most favorable cases that come to us for treatment, we operate on the presumption that metastatic migration has followed the widest and most direct highway (the axillary route), and that the less frequented byways of travel have not yet been utilized by the enemy. Success in avoiding intrathoracic and

visceral metastases must, therefore, remain, to a large extent, an affair of chance; not of certainty that all the avenues of escape from the primary focus have been completely cut off. Hence it is that the words constantly used to qualify the operation of the day, as "complete" and "radical," are anatomical misnomers, which serve solely to indicate evolutionary phases in the surgical technique, and are illusory if used in the sense that they root out the evil with any degree of certainty.

By the side of this decidedly gloomy and forbidding prospect presented to us by the study of the anatomical limitations which surround the surgery of cancer of the breast, we can hold up the results of clinical experience, as gathered in the last twenty years, as a contrast which more hopefully contradicts the preceding *a priori* considerations. Indeed, the experience of the last two decades, and more especially of the last ten years, has taught us several important and interesting facts. It has taught us, first of all, that by *more thorough* operating, the primary focus of infection can be eradicated, with far greater certainty of non-recurrence *in loco* than was previously believed possible. The comparative statistics as to local and regionary recurrence show this plainly. For instance, the results of the older operations, as worked out by Dr. Halsted, show that in Billroth's cases there were 85 per cent. of local recurrences; in Czerny's, 62 per cent.; in Fischer's, 75 per cent.; Gussenbauer's, 64 per cent.; Volkmann's, 59 per cent.; Gross', in 1880, 68 per cent. If we compare this with the extraordinary fall to 6 per cent. in Halsted's first 51 cases (1894), or even if we include his 8 cases of *regional* recurrence in the category of local recurrences, we would still have only 22 per cent. local recurrences in the practice of this distinguished operator. That this is not an accidental improvement due to individual conditions is shown by the results obtained by subsequent operators which are even better.

For instance, Watson Cheyne's cases (1896), after three years' observations, showed only 18 per cent. local recurrence. Rotter (1896) notes only 14 per cent. local recurrences in his cases; Dennis (1896) in a series of 45 cases, observed for three years, only 5 per cent. Even admitting that these are the records of individual operators who deal with comparatively small groups, and that they do not indicate the true average obtained by the generality of surgeons, we must admit that the demonstrated possibilities of surgical work in this direction are surprising and encouraging. I believe that Jœrss' more recent estimate (1897), which he obtained from a study of 76 cases

operated by four surgeons (Heidenhain, Rotter, Helferich, Watson Cheyne), yielded a result of 30.3 per cent., which is nearer the true general average of local recurrence that may be expected after the most aggressive modern operations. Up to 1894, my own results after an extensive operation, which was modelled on the lines laid down by Gross and Volkmann, which I performed up to that time, were 40 per cent. local recurrences. Since that time I have operated exclusively by the procedure advocated by Halsted and Meyer, and thus far the number of recurrences has been 33.3 per cent., many of the cases having not yet reached the three-years' limit. This improvement is so slight by comparison that I have been disappointed, though I believe the comparative lack of improvement in my last series of cases is susceptible of favorable explanation, as will be seen later. Nevertheless, when taken as a whole, the improvement brought about by the present methods of operating are sufficiently encouraging to deserve congratulation.

A far more important question than that of local recurrence is that which refers to the actual number of *cures* obtained by present methods. Here, again, the statistical evidence is also encouraging. In the latest compilation presented by Bennett May (1897) we find the improvement in the percentage of recoveries that have stood the three-years' test to be as follows: Billroth, in 1876, claimed only 4.7 per cent. of cures; Küster, in 1881, 21 per cent.; Koenig, shortly after, 23 per cent.; Bergmann, 39 per cent. Average of Rotter, Helferich, and Watson Cheyne, in 1896, 49.5 per cent. Watson Cheyne found that in a collection of 1491 cases, collected from various sources and operated by older methods, 14 per cent. had been cured. Compared with 111 recent operations which yielded 34 per cent., the result in favor of later methods is certainly marked. But these results are positively brilliant when we sum up the work of individual operators, though the value of their conclusions is minimized by the small numbers in each series. For instance, in 21 cases Watson Cheyne obtained 57 per cent. cures. More remarkable are the results obtained by Dennis, who recorded 45 per cent. cures in his first series, and in his last 15 cases (1896) 83 per cent cures which had stood the three-years' test.[1] These last figures are surprisingly brilliant, and no doubt show the absolute maximum of efficiency that may be obtained by individual operators in limited and, no doubt, very favor-

[1] Dennis' Surgery, vol. iv. p. 932.

able groups of cases. I can scarcely believe that they will ever indicate the general average of cures, even under favorable conditions, when larger compilations are obtained. My own experience with permanent cures has been decidedly contradictory as far as showing the relative merits of the older and the new methods, as is shown in the synopsis of 27 cases which I have appended to this paper. It will be seen that up to 1894, when I operated by a method which is at present classed with the incomplete operations, though it only differed from the present in the fact that I did not remove the pectoral muscles or attack the post-cervical region, I obtained 41 per cent. of recoveries which have stood the three-years' test and over. Since 1894 I have exclusively performed the Halsted or the Meyer operation, and have to deplore 61.7 per cent. failures (deaths from metastases and recurrences), and can only claim 38.3 per cent. recoveries, none of which have passed the three-years' limit. These results simply show the unreliability of small groups for statistical deductions, and should in no serious manner affect our comparative estimate of the old and modern operations. I will not dwell now upon this phase of my experience, but simply call attention to the fact, clearly established in my mind, that, notwithstanding all the fallacies of statistics, the *collective* evidence gathered in the last five years shows that a marked increase of permanent recoveries has followed the more thorough operations of the present period.

In the presence of all the facts that we have considered we are now ready to ask ourselves the following questions: What are the prospects of advancement that the future holds in store for the surgical treatment of cancer of the breast? Has the operative manual reached its maximum of perfection? Can we expect still better results from more extensive and aggressive operations, or must we now depend solely upon earlier diagnosis for early intervention and better opportunities to increase the effectiveness of the present procedures? As far as I am concerned, and judging purely from my personal experience with Halsted's and Meyer's operations, I firmly believe that surgery has here nearly reached, if it has not already attained, its maximum expression of effectiveness, beyond which it is absolutely impossible to advance without certain risks of life or with any further expectation of increasing the chances of permanent recovery. It is clearly fixed in my mind that all that surgery can do is to thoroughly eradicate the primary focus of infection in the breast together with

the extra-thoracic areas of lymphatic contamination. Beyond this it is impossible to go further with any reasonable prospects of success unless it be in very exceptional and isolated cases. If such is the case, the success of surgery in coping with cancer of the breast must be estimated by the *future* statistics of the *present* operation. While we cannot consider the experience that has thus far accumulated as sufficient to estimate the best average results, enough evidence has been gathered to show that in the hands of the most experienced operators this *optimum* average will rarely exceed 50 per cent. On this point I thoroughly concur with the opinion recently expressed by Bennett May when he says: "So far as is at present known our only hope of advancement lies in the direction of more thorough and more early operation. The limit of what is possible in the former direction will soon be reached, if it is not already reached. The result must carry conviction that we may hopefully anticipate a real cure in at least 30 or 40, or some would say, 50 per cent. of our cases. I would not like to place 30 as a rule, but it is with somewhat chastened hope that I look for anything beyond."

I would repeat again, that the real hope for improvement does not rest so much upon an extension of operative procedures and perfection in the technique, but in an early recognition and earlier extirpation of the primary focus of invasion. The best results are bound to follow the practice of that operator who, being skilful and conscientious, is fortunate enough to deal with the most intelligent patients, who will seek his aid promptly and who will give him the opportunity to attack the disease in its earliest stages, before secondary metastases have had time to develop. It is this factor, early diagnosis and early operation, that accounts most satisfactorily for the different experiences of different operators, and by the same operator in different series of cases. This fact is strikingly illustrated by my own limited experience, as shown by the synopsis herewith appended.

Here we see that since 1894 I have operated upon a series of cases by the most radical and complete of present methods (Halsted's, Meyer's), and yet I have against my record 67.7 per cent. of failures, whereas in the preceding series of 10 cases, treated by less severe methods, I have had 40 per cent. recoveries, with only 33 per cent. total failures. While the mere bald statement of these figures might at first sight appear to detract from the merit of the more extensive operations, they do not diminish my appreciation of their superiority under

similar conditions and circumstances. The reasons for the greater number of failures in my last series of cases is best accounted for by the nature of the cases themselves, and by the fact that with the greater confidence and experience acquired in my early operations I unwisely undertook to operate on advanced cases which I probably would have refused to touch in earlier days. I have now done the more radical operation, as formulated by Halsted and Meyer, often enough to convince me that in very advanced cases (meaning by this those in which the upper axillary, subscapular, and posterior cervical lymphatics are markedly involved), it offers no more prospect of cure or chance of escape from internal metastases and secondary recurrences in the neck than obtained by the older and less mutilating operations.

The new operation will unquestionably greatly diminish the probability of *local recurrence*, but the patients will die, as a rule, just as quickly by regional and internal metastases as if a superficial operation had been performed. For this reason I now generally prefer not to operate in cases in which, in addition to marked axillary involvement, there is distinct palpable, enlargement of the deeper supraclavicular lymphatic chains. Another class of cases which I consider hopeless are those in which the base of the gland is involved and has become fixed to the chest wall; the prospect is still worse if, in addition, the sternal quadrant has been originally involved. In addition to these purely topographical conditions that have impressed me as being of particularly bad omen, there are well-known histogenetic peculiarities of the growth itself, the extent of the axillary involvement, such as total infiltration of the axillary fat with subscapular prolongations incorporating the vessels and nerves, the existence of disseminated lenticular deposits in the skin of the paramammary region, the enlargement of the sternum, revealing the marrow infection, so much insisted upon by Herbert Snow, the evidence of visceral metastases—all conditions which are justly regarded by nearly all operators as positive contraindications to operation.

Now, a few words as to the operation itself. Notwithstanding the fact that my best results have been obtained by an operation which carried out the earlier teachings of Gross, Volkmann, and Banks, I have unhesitatingly adopted the principles of Halsted's operation ever since he described it in 1894, and thus far I have seen no reason for returning to more primitive methods. By adopting Meyer's sug-

gestion to detach the major pectoral from its humeral insertion, I am satisfied that the operation is very much expedited by obtaining a prompt control of the chief vascular supply of the field. The removal of both pectorals is a procedure that is surprisingly free from bad functional effects, for apart from some stiffness and inability to raise the arm to the back of the head the patients complain of comparatively little inconvenience. It certainly does not appear to add to the gravity of the operation. It does, on the other hand, greatly facilitate not only hæmostasis but the prompt, complete, and safe exposure of the entire axilla, supraclavicular triangle, and subscapular space. It also permits the operator to remove the entire area of visible infection from the axilla to the breast *en bloc*, in a remarkably effective manner. In the axilla I have given up trying to save any vessels or nerves except the parent trunks and occasionally the long scapular and posterior thoracic. The axilla is thus cleared *in toto*, leaving the axillary plexus perfectly clean in the arm-pit. In clearing the supraclavicular fossa I have never found it necessary or justifiable to divide the clavicle. The clearing of this space I have found to be the most unsatisfactory part of the operation, because I always feel that the deep trapezial set of glands and the chains that accompany the subclavian vein are only partially touched. I have come to the conclusion that the thorough cleaning out of the space between the clavicle and the scapula and above it, will do very well as a *prophylactic* procedure when the glands of this region are apparently normal; but when they are already *visibly* involved I feel confident that a zone of infection has spread beyond them, and that the key to the general lymphatic system has been hopelessly surrendered to the enemy. In conclusion, I would state that whatever the fallacies that underlie the so-called radical operation for cancer of the breast, as a curative procedure, we are under lasting obligations to Dr. Halsted for the suggestion and demonstration of an operation which synthetizes in itself all the resources that modern surgery can bring to bear against this most formidable disease.

Synopsis of 27 Operated Cases of Malignant Disease of the Breast or its Immediate Vicinity, from 1887–1898.

Twenty-six of these were women, one man. Of the 26 women, 18 were multiparæ, 8 nulliparæ. The average age, 47 years. In 20 of the cases microscopical examination was made and revealed epithelial

growths in 18, and sarcoma in 2. In the remainder the diagnosis was clinical, but the malignant character of the neoplasms was amply confirmed by the clinical evidence of the cases. All the patients made satisfactory and, in the majority, excellent recoveries. There were no fatal cases from operative causes.

Of these 27 cases, 11 are living and well, though 1 has had three recurrences in three years and ten months; 1 is living but has now marked and inoperable recurrences and metastases, nearly four years after operation; 1 was well two years after the operation, but has not been heard from since; in 2, death resulted from accidental causes not connected with the operation; 12 have died from either local recurrence, metastases, or general dissemination.

Total, 27 cases; 10 living and well and *free* from recurrence (33.9 per cent.). There were 14 recurrences, of which 12 have proved fatal already (51+ per cent.).

The operations performed upon these 27 patients may be grouped as follows: 2 excisions of the breast with simple exploratory incision into axilla; 8 "Gross" operations; 17 complete (Halsted) operations: total 27 operations.

Summary of Results. (*A*) So-called incomplete operations performed prior to November, 1894. Two cases treated by simple excision of breast with exploratory incision into axilla: 1 survived two years, but died finally from metastatic cancer of uterus; 1 still living (male) eight years after operation, and is now free from local recurrence.

(*B*) Ten cases treated by excision of the breast and extirpation of axillary contents ("Gross" operation): 4 are living and have not had recurrence; 1, five years + three and one-half months after operation; 1, four years + seven months after operation; 1, three years + ten months after operation; 1, three years + eight months after operation.

One is living three years and seven months after three operations for local recurrence, the last of which was performed two months ago. One is living three years and two months after operation, but has inoperable recurrence in neck and mediastinum. Three have died from local recurrence or metastases. One was well two years after operation, which was performed ten years ago, but has not been heard from in the last six years.

Total, 10 cases treated by the Gross method, and, if we include the 2 incomplete cases, = 12 cases operated prior to November, 1894.

Of these, 5 have resulted in complete recovery, without recurrence, fully beyond three-years' limit (or 41+ per cent.). If we include 1 case that is now well after three recurrences, = 60 per cent. recoveries. Four recurrences, of which 3 have died (33+ per cent. deaths, and 40 per cent. recurrences). One result unknown.

"Complete" Operations since November, 1894 (Halsted, modified by Meyer's Suggestion).

Two died from causes not connected with operation, viz.: One died, one month after a complete Halsted operation (March 20, 1895), from the effects of extensive burns; one died from acute softening of brain caused by embolism, two years and two months after Meyer operation, performed February, 16, 1895. Eight cases have proved fatal from either local recurrence, metastases, or general dissemination (63+ per cent.). The following is a synopsis of the cases:

CASE I.—Colored (mulattress), aged forty-eight years. Operated November, 1894. Advanced acinous (scirrhus) carcinoma of breast, with general involvement of axillary glands. Complete extirpation with pectoralis major, and minute dissection of axilla and supraclavicular space. Recurrence in higher cervical glands and lenticular nodules in neighborhood of scar nine months after operation.

CASE II.—White, religeuse, aged fifty-nine years. Advanced scirrhus of breast with marked axillary involvement. Halsted's operation, May, 1895. Recurrence in axilla and cervical glands. Death from cervical diffusion and intrathoracic metastases thirteen months after operation (recurrence marked, nine months after operation).

CASE III.—Israelite, aged thirty years. Mother died of primary mediastinal sarcoma. Rapidly growing adenosarcoma of breast. Complete operation, both pectorals, February 23, 1895. Death twenty-three months after operation from metastases in liver which grew to prodigious size. No local recurrence.

CASE IV.—Israelite, aged thirty-four years. Tumor appeared during pregnancy and attained enormous proportions during lactation in the only breast that was utilized to suckle the infant. Complete operation, both pectorals removed, April 10, 1895. Metastasis in lower jaw (central myelogenous sarcoma) with rapid involvement of submaxillary region in nine months. Death nine months after operation

from ligneous infiltration of neck, asphyxia, and mediastinal growths, adenosarcoma.

Case V.—White, aged thirty-nine years. Scirrhus of breast and axilla. Halsted's operation, December 12, 1894. In ten months nodular deposits in cicatrix. Death, twenty months after, from general dissemination, especially in prevertebral and lower carotid groups.

Case VI.—White, aged sixty-three years. Scirrhus of breast and axilla. Complete operation. Deep mediastinal metastases, one year and ten months after operation. Death with marked œdema of face and upper extremities, especially right upper limb, and great dyspnœa and cyanosis from laryngeal compression, two years and four months after operation. No local recurrence.

Case VII.—White, aged fifty-four years; very fat. Tubular carcinoma of breast (clinically encephaloid appearance) and axilla. Halsted's operation, November 25, 1895. Recurrence January, 1896. Secondary operation; death, March, 1897, from local axillary and general metastases.

Case VIII.—White, aged thirty-two years. Carcinoma of probable supernumerary mammary gland near axilla, with marked involvement of axillary contents. Halsted's operation, January 3, 1896. Formidable and nearly fatal attack of erysipelas during convalescence. Recurrence in neck and lower angle of cicatrix far removed from original seat of growth, in December, 1896. Rapid distribution and fusion of metastases in neck along carotid tract; death eighteen months after operation in great agony.

Synopsis of Five Cases that are Living Without Recurrence after "Complete" Operation.

Case I.—White, aged forty-eight years. Acinous (scirrhus) tumor of breast and axillary involvement. Halsted's operation, January 10, 1896. Excellent functional result, and is well at present without sign of recurrence one year and three months after operation.

Case II.—White, aged sixty-three years. Scirrhus in axillary quadrant; axilla involved; operation January 25, 1896. Is now well, no sign of recurrence, one year and ten months after operation.

Case III.—White, Israelite, aged fifty-four years. Upper half of left breast; scirrhus. Complete operation February, 1897. Is now well and free from recurrence—one year and two months after operation.

Case IV.—White, aged fifty-eight years. Rapidly growing carcinoma of breast with axillary involvement. Complete operation March 4, 1898, over one month since operation; wound healing.

Case V.—Colored, aged thirty-four years. Scirrhus of breast and axillary involvement. Complete operation April 2, 1898. Wound healing.

If we exclude the 2 cases that died from accidental causes, not connected with the operation, we have a total of 13 cases to be considered. Of these, 5 are living and 8 dead, *i. e.*, 38.3 per cent. recoveries, none of which have yet passed the three-years' limit, and 61.7 per cent. fatal cases. In 5 of the 8 fatal cases there was local recurrence alone or coincident with evidences of infection higher up in neck or elsewhere—33.3 per cent. local recurrences. In 3 death was caused by fatal metastases in mediastinum, liver, or jaw (2 of these sarcomas) without apparent local recurrences.

Dr. Charles B. Nancrede, of Ann Arbor.

I would like to say a word in reference to age. My experience is limited to between 200 and 300 cases of cancer of the breast, and I have been struck by the comparatively large number that occurred under thirty years of age. This winter I operated upon a girl, in the early part of her twenty-third year, in whom, unquestionably, the tumor had been observed in the latter part of her nineteenth year. The axilla was filled with cancerous glands. I would like to know if there are any surgeons present who have had a case as young as this. Also, does any one's experience coincide with mine as to the relatively large number that occur before thirty?

Dr. Roswell Park, of Buffalo.

(Asked Dr. Halsted what his teaching is in regard to endothelioma.) I notice that one of the diagrams is marked alveolar sarcoma. I am anxious to know what is the teaching of the Johns Hopkins authorities concerning alveolar sarcoma and endothelioma.

Dr. Maurice H. Richardson, of Boston.

What Dr. Halsted has written on the subject in the past has been a great stimulation to us in Boston to carry out extensive dissections. The results which he had secured by so doing have encouraged us to

follow suit. He refers to the early infiltration of the axillary glands, but I have observed many cases where there has been no such infection. There have been cases in which nothing could be seen or discovered, and I recollect two cases in which the diagnosis of tumor was made merely upon the symptom of pain, as no tumor could be felt. In these cases, in which nothing could be felt, there was not only an infection of the axillary glands, but early recurrence, and in two cases death. The cases in which the recurrence has been slow have been those in which there was no infection of the axillary glands. I wish to express my appreciation of the statement as to the value of gross appearances. I have recently seen a case in which the microscopic appearance could not possibly agree with the diagnosis. I am glad to say that the clinical appearance showed that we were right; one of the cases was carcinoma of the tongue. I must regret my failure in the past to observe these cases, but lately I have recorded every case I have seen. As to the cured cases, we have had a number of recurrences after the lapse of a long time, say from seven to ten years, and the recurrence in two or three cases has only been apparent by a small spot. This has made me feel that three years is not sufficient to consider a cure. I cannot believe that cancer is cured if it occurs two, three, or four years after an operation, nor do I believe that it is a new cancer. The subject is one of great general interest, and I must say that I have determined to see if we cannot do as extensive operations as those recorded, and prove our results.

Dr. Joseph D. Bryant, of New York.

I wish to express my appreciation of the paper and to state my belief in the propositions which have been laid down and which I have been practising lately in every case.

In reference to Dr. Richardson's remarks, I would like to state that in more than one instance I have found enlarged glands in the axilla, and in some instances where the increase in size was not sufficient to warrant the belief of their infection until a careful microscopical examination had been made. I believe Dr. Halsted recently reported a case in which the infected gland was so small that it occupied the entire field of the microscope.

In my judgment, if the lymphatic glands are affected their removal generally becomes necessary in order to attain a higher order of success. It is unnecessary to state that sometimes those who are in the

possession of a morbid growth cherish the knowledge themselves for some time. I think it is not infrequently the case that physicians, sentimentally or otherwise, encourage patients to believe that they have not a malignant disease. The first duty now is to impose upon the profession and patients the fact that the presence of an abnormality demands prompt recognition and treatment.

Dr. J. McFadden Gaston, of Atlanta.

Dr. Halsted alludes to the occasional disappearance of the carcinomatous formation, and I would like to inquire if he has observed the effects of constitutional measures employed synchronously. I have been impressed with the effect of constitutional methods when brought to bear on this disease.

Dr. Park. As to the spontaneous disappearance of these tumors, I have been collecting data for several years and am anxious to get together as much information as possible. I believe it does occur, as I have seen it in my own practice, although there is a wide difference of opinion among surgeons on this point. The case referred to this morning is extremely suggestive, and I shall be glad if any of the Fellows can give me further information.

Dr. Halsted. Such a very hearty and apparently unanimous indorsement by this society of our views as to the treatment of breast cancer is indeed most gratifying to me.

I had hoped that Dr. Matas might offer some explanation of the marvellously good results which he obtained by the older methods in the treatment of breast cancer; for we all, undoubtedly, have known surgeons of large experience who have stated that they had not cured a single case of breast cancer.

No, Dr. Nancrede, I have no personal knowledge of any case of carcinoma of the breast in a patient so young as nineteen years, nor do I know of any reliable reports in modern times of cases in young girls.

In answer to Dr. Park, endotheliomata are alveolar sarcomata, but we cannot say that all alveolar sarcomata are endotheliomata. One often finds strands or columns of endothelial cells resembling cancer in fibro- and myxosarcomata and in the mixed tumors of connective-tissue origin in the parotid gland and testicle. There are some who, like

Hausmann, of the Virchow School, regard endotheliomata as carcinomata, for, prior to the studies of Waldeyer and Thiersch, Virchow held that all carcinomata were of connective-tissue origin.

As to the spontaneous disappearance of carcinomata and the inquiries of Dr. Park and Dr. Gaston, I can testify to the almost complete, if not complete, disappearance within the past three months of a recurrent cancer of considerable dimensions which I have been carefully watching for three years, and which, for twelve or thirteen years, has been gradually if almost imperceptibly growing. In this case there are extensive and unmistakable metastases in the axillary glands and sternum which have not disappeared. It was after an attack of "grip" (possibly a streptococcus "sore throat") that the breast cancer first showed signs of diminution in size.

An epithelioma of the face, observed by Dr. Finney and several of our assistants in the dispensary, disappeared entirely after a severe attack of facial erysipelas. I might mention in this connection that large mycosis fungoides tumors vanished, for a time at least, after a very severe attack of erysipelas induced by inoculation.

I am very much interested to hear that Dr. Richardson has operated upon so many cases of cancer of the breast prior to the involvement of the axillary glands. Exclusive of four of the adenocarcinomata which I have just described in detail, we have met with only two cases of breast cancer in which, at the time of operation, the axillary glands were not involved.

I wish it were possible to enlighten the people, as well as the physicians in all parts of this country, on the subject of breast cancer, and make them realize how important it is that the operation should be done as soon as the tumor is discoverable—there are so many physicians who still consider operation for cancer useless, and some who believe that they can dissipate the new growth by nostrums. Patients frequently come to us of their own accord against the will of the doctor.

AN INQUIRY INTO THE ETIOLOGY OF CANCER.

With Some Reference to the Latest Investigations of the Italian Pathologists.[1]

By ROSWELL PARK, M.D.,
BUFFALO.

The subject of the etiology of tumors, benign and malignant, seems to me the most important and, at the same time, vexed problem now before the surgical pathologists of the world. The universality of their distribution, their general prevalence, their horrible malignancy, and the futility of all save operative methods of treatment, combine to make cancers the most dreaded, because the least understood, enemies of the human race.

To attack this problem successfully, pathologists of the future must begin by studying tumor-formation in the vegetable world before studying it in animals—*i. e.*, the comparative method of investigation must be adopted.

Xylomata, or woody tumors, are so exceedingly common that they have failed to attract the attention which they deserve. A large proportion of these growths in trees and shrubs are of parasitic origin; the rest of them are undoubtedly due to disturbance or injury, such as follow traumatic or external irritation. A careful study of them will lend great aid in attacking the problem in its highest phases. Nevertheless, this is not the place to go into details of this description. It may not be amiss,

[1] In submitting the following paper as coming from the Committee on Nomenclature and Study of Tumors, I wish, first of all, to assume the responsibility for any opinions therein expressed. The other members of the committee have kindly permitted me to present this communication as a report, in which, nevertheless, they have not taken personal part.

however, to point out the great benefit that would accrue from a combination of botanists, zoologists, veterinarians, and our own profession, for the purposes of mutual aid in this matter.

Much reason as there is to consider malignant disease as in all probability an expression of infection, it will be worth while to devote a little time to the consideration of the causes of the more common benign tumors.

The *lipomata* are the most frequently met with of all, and must find their explanation in some disturbance of nutrition due to faulty innervation. This is easily explained, since they are usually of traumatic origin. The injury has usually been so slight and so long past as to be forgotten. Lipomata are frequently multiple, and then usually symmetrically placed, and such distribution can only be explained through the agency of the nervous system.

Fibromata, also, are usually of traumatic origin, and, if careful investigation be made, the majority will be found to contain minute foreign bodies, such as slivers, splinters, etc., which have served as the exciting cause, and which give these growths a strong resemblance to many of the xylomata already referred to. This is especially true of those fibrous tumors found about the hands and feet.

Myofibroma of the uterus, which is, strictly speaking, leiomyoma, has been of late regarded as of parasitic origin. Without placing great reliance upon the discovery, recently reported, of actual parasites, it is worth while, at least, to remember that some years ago Billroth made a careful study of these growths, and found that they always commenced by formation around a small bloodvessel. If, now, this be true, we are compelled to view such neoplasms as due to something circulating through the bloodvessels—*i. e.*, carried by the blood current, and consequently, necessarily parasitic.

Chondroma is by all means most common in infancy and childhood, and its consideration is practically inseparable from that of rickets. Such cartilaginous tumors as are not to be explained as expressions of rhachitis are to be regarded as inclusions, according to the embryonal theory of Cohnheim.

Osteoma is, for the most part, to be explained on embryonal grounds (Cohnheim). It is often seen as an exostosis in the neighborhood of an epiphysis, or as an ossification of some cartilaginous "rest;" in many other cases it is the result of traumatic osteoperiostitis, or of syphilis, or rhachitis.

Adenoma is the nearest approach to a malignant tumor which is consistent with a non-parasitic theory, and every surgeon knows how frequently an adenoma becomes converted into carcinoma. It requires only the added impetus of a parasite, to convert an innocent enlargement into an exceedingly malignant growth.

When now we come to *malignant tumors*, the only two theories which are at all worth consideration are the embryonal and the parasitic. All others are either secondary or subsidiary and included in one of the above. Thus the influence which trauma, previous inflammation, diet, surroundings, etc., may exert is to be regarded just as one would regard the same things in predisposing to or permitting tubercular or pyogenic infection.

The evolutionist's view of cancer is not, necessarily, that of the comparative pathologist, although they cannot vary much. If we accept, for instance, Williams's definition of cancer as "the expression of an indefinitely sustained power of certain cells to grow and multiply in excess of normal requirements," we have one which will apply to tumors either in vegetables, trees, or animals.

In the vegetable kingdom, it is hard to draw a distinction between various grades of malignancy. Nevertheless, that tumors kill a large proportion of trees and shrubs will not be disputed by those who have studied the subject. While the method of death in plants or animals is essentially the same—*i. e.*, through ulceration, starvation, and toxic action—the fact that diet cuts some figure among animals in this regard has been shown by Rayer, who found that carnivorous animals are more prone to cancer than herbivorous, just the reverse being the case concerning tuberculosis.

The evolutionists have shown us that an adult cell has a power of relapsing to an earlier or primitive condition, and thus

may commence the neoplastic process. Thus cancers, as well as certain processes of repair, are by some regarded as reversions. The embryologists have also shown us that little particles, or foci, of embryonal cells may become embedded in adult tissue, still retaining their primitive or unspecialized characteristics with their accompanying powers of independent growth.

The rapid multiplication of muscle-fibres in the uterus during pregnancy, or of the heart in hypertrophy, or of the connective-tissue corpuscles in healing wounds, has shown us that cells of all descriptions possess remarkable reproductive powers in the presence of proper stimuli. In a genuine hypertrophy the new cells are a perfect type of their ancestors and, as such, are true to the organism. Among benign tumors these new cells form by cellular division, and are of no utility to the organism. Imperfectly bred new cells may be of value to the body, as in cicatricial tissue; but the cells which have fallen from the first estate of their ancestors and are of a lower grade of vitality, and have become hostile to the organism, are those seen in sarcoma and carcinoma. This is the briefest and best epitome of the evolutionist's view of cancer.

Cancer has been also happily defined as an abortive attempt of gland epithelium to reproduce itself, in which respect it is a constant parody on true gland tissue. Sarcoma is a similar process pertaining to mesoblastic cells. It must now be asked, can this failure in cell-breeding be accounted for only by a tendency to reversion, or only by the invasion of parasites, or by the occasionally inevitable combination of both? The evolutionist will insist that his view is correct, and that a parasitic feature, if present, must be accidental and secondary. In doing this he will claim that the essential, predisposing cause of cancer is senility. In other words, that just as soon as the food supply begins to fail, liability to cancer begins, and that such malnutrition may result either from functional senility, or atrophy and instability, due to ancestral and reversionary tendencies. Thus, in the mamma and uterus, when function ceases such malnutritional changes commence. In the lips and

tongue atrophic alterations are largely due to loss of teeth; while at the pylorus, the old gizzard region, we have a very common site for cancer. Or, to sum this up, just so soon as an organ or tissue begins to fail of nutrition, it is apt to begin preying on its own kind, like a plant running to seed in poor soil, in a desperate endeavor to hold its own, which, as Jonathan Hutchinson has termed it, is, in fact, a *rebellion of cells;* and which, as his nephew, Woods Hutchinson, puts it, is, like many another rebellion, chiefly provoked by starvation and want.

Fascinating as is this view, it is, nevertheless, quite insufficient for our purpose. We used to be taught that cancer was exceedingly prevalent at certain ages, and perhaps this statement is correct when one sees but few instances of this trouble. For myself, however, living in a region where cancer is exceedingly prevalent, I have to witness the ravages of this disease in many relatively young people who are far below the supposititious cancer age; and the average practitioner who fails to recognize a malignant growth merely because he finds it in a young person, is as sadly misled by old statements as is he who makes the same mistake because the patient did not complain of lancinating pains.

There are certain clinical considerations pertaining to the study of cancer which can hardly be omitted in a paper of this general scope.

(*a*) Influence of *sex*. Williams found, for instance, that for every 100 males dying of cancer, 223 females perished from the same disease. Of late years the disproportion has somewhat diminished; nevertheless, women are still more subject to malignant growths. Of cancer in women the breast is involved in 40 per cent., the uterus in 34 per cent., while the rest of the body furnishes the other 26 per cent. In males the parts about the mouth yield about 40 per cent. of the cases. Out of 1878 consecutive cases of cancer of the breast in both sexes the male mamma was involved in only sixteen instances. This discrepancy between the sexes holds good mainly with regard to carcinoma, sex displaying but little difference in regard to liability to sarcoma.

(*b*) The most prolific cancer-producing *age* is that between the fifty-fifth and sixty-fifth years of life—*i. e.*, at a time when the various organs are less active. With the period of tissue and organic maturity, the liability to cancer begins and increases until about the sixtieth year. That the uterus and breast are commonly attacked at an earlier age than other organs is due to their having become *passe* with the conclusion of child-bearing life. With the waning of developmental activities the danger of cancer increases, subsiding only when the organs have undergone complete atrophy. This is true of all known infections, whether cancer be one or not.

(*c*) Williams' careful studies have shown that, at least among females, there is a greater liability to cancer in *brunettes* than in blondes; although the blonde type prevails generally among the population. he found the disease was twice as frequent in brunettes as in blondes. Beddoe furthermore states that red-haired individuals are the most exempt of all. From our own census reports it appears that cancer is twice as frequent among whites as among blacks.

(*d*) *Heredity* of cancer is one of the most vexed questions regarding the dread disease. A family history of cancer will be obtained in from 25 to 35 per cent. of the cases; nevertheless, we must hold that not the disease, but only the liability to it can be transmitted from parent to offspring. Even were the disease strictly hereditary, we should find a striking disproportion between it and congenital deformities or defects, or supernumerary organs, which are not transmitted from parent to offspring in anything like 25 per cent. of instances. While a history of multiple instances of cancer in the same family is extremely suggestive, it remains yet to be determined to what extent environment or infection from common sources may account for it. In other words, a notable family history of cancer is, of itself, rather an argument for the parasitic nature of the disease; while the so-called cancer houses have been more or less carefully studied by a London commission.

If cancer is transmitted by heredity it should tend to die out in the course of transmission, as do all abnormalities. Thus

Buxton found that out of 300 marriages in which both husbands and wives were deaf and dumb, the offspring were similarly affected in only 5 per cent. of cases, while of deaf mutes married to those that could hear the proportion of affected offspring was only about two-thirds of one per cent. Williams' reported two instances in which both parents were cancerous, who produced seven childen, of whom two had the disease, as well as his collection of seven marriages in which only one parent was cancerous, from which resulted sixty-two children, of whom ten had the disease, are extremely important although we are not able yet to correctly interpret their entire significance. In this connection, also, there is Broca's celebrated report of the twenty-six descendants of cancerous parents who had attained or exceeded the age of fifty years, of whom fifteen died of the disease.

Williams further concludes that a large proportion of cancer patients are the surviving members of tubercular families; as also, that among families in which cancer prevails there is unusual fecundity, the children averaging four and six-tenths in healthy families, whereas in cancerous families they average eight and eight-tenths to each. Cancer appears to prevail in those who are subject to hypernutrition, this being true even of the survivors of tubercular families.

(*e*) Beneke has described cancer patients as having large hearts and arteries and small lungs; whereas in tuberculosis we have to do with small hearts and large lungs. Beneke also noted that cancers are rare in prisons, where animal food is not freely furnished and where work is hard. Nevertheless, vegetarians are by no means exempt.

(*f*) There can be no doubt but that cancer is upon the increase. In 1840, in England, the proportion of deaths from cancer, as compared with the total mortality, was 1 in 129; in 1880 this had risen to 1 in 28. Williams estimated a few years ago that at least 40,000 persons were suffering from cancer in England and Wales; this augmented cancer mortality rate became conspicuous, notwithstanding great improvement in the general sanitary condition. In 1861 there were in England 376

deaths from cancer to the million of population. Twenty-five years later there were 610, and this at a time when the death-rate from phthisis had notably diminished. There can be no doubt but that the proportion of this increased death-rate may be in part accounted for by more accurate diagnosis; nevertheless, the death-rate is unquestionably double what it was twenty or thirty years ago.

From the maps of the United States Census Bureau, as well as from various sources, I have learned that Buffalo, N. Y., is near the centre of an area some two hundred miles in radius where the death-rate from cancer is larger than in any other part of the United States. So prevalent is the disease with us that I have often made the remark that it is we who live in the "Tropic of Cancer."

From the returns of the New York State Board of Health during the ten years from 1885 to 1895 I find that there have been reported 30,692 deaths from cancer. In 1885 there were 1882; in 1890 there were 2878; and in 1895 there were 3454. In other words, in the last year of this decade the total number of deaths from cancer was twice that of its first year. It would seem to me, then, that I certainly have a right to claim that the disease is increasing in frequency.

When Haviland published, in 1892, his *Geographical Description of Heart Disease, Cancer, and Phthisis for England and Wales*, he maintained that cancer is most prevalent in countries traversed by rivers, especially those which flood it; and less prevalent in mountain regions or where floods do not occur. Thus he finds that the river Thames runs through a vast cancer field, save only where the chalk crops out. But Williams would explain the prevalence of the disease in the Thames Valley by the conditions of life peculiar to its population. He claims that cancer mortality is lowest where the struggle for existence is hardest, the population densest, the average duration of life shortest, and where the death-rate from tuberculosis is highest —*i. e.*, among the working classes; and that cancer mortality is greatest where the general standard of living is higher and life more easily maintained.

Much, also, of interest can be gleaned from the researches of Noel, which go to show a certain relation between arboreal cancers and those of man; that is, not only the frequency of malignant tumors in habitations surrounded by or near woods, but the relatively large mortality from cancer among those persons whose occupation obliges them to live amid these surroundings. The statistics of Julliard, Bierry, and Fiesinger, as well as his own, show that excise officers, who, in certain parts of the country, pass most of their time in isolated paths through woods, are very prone to cancer, as well as those country laborers who work in the woods. For instance, at Lyons, cancer of the lip is said not to exist; rather, all those who go there to be operated upon for this lesion come from the fields.

Cancer-bearing trees are not only exceedingly prevalent in woods and orchards, but it would seem that this plant lesion is contagious, many of them being found in the same neighborhood. Cancer seems to be most frequent in individuals living in isolated houses on the wooded banks of rivers. Insects, as Morau has experimentally shown, and especially the large wasps found in woods, seem to have a decided predilection for arboreal cancer, and may not only carry the infective material from one tree to another, but deposit it in human food. On these insects, both protozoa and fungi abound. Hence, the question may arise, Can cancer be disseminated through the agency of such insects, or can water, especially in the neighborhood of woods, act as a medium of transport? If the disease be conveyed in food, cancer of the alimentary tract will be the result; if by the finger or skin, any external portions of the body may be affected. The common solitariness of cancer infection in man is often emphasized as an argument against the parasitic theory, but it is now universally conceded that cancer may originate by multiple foci, and that general carcinomatosis and sarcomatosis correspond perfectly to miliary tuberculosis.

Hitherto inoculation experiments, at least in man, as well as for the most part upon the lower animals, have failed. There

are a few apparently authentic instances of transmission to the husband from cancer of the uterus. There is also much reason to think that about the mouth and perineum, where the mucous surfaces lie closely in contact, the disease may be spread from one part to another.

Experimental auto-inoculations have practically failed. In 1885 Morau reported inoculation of fragments from an epithelial cancer of a white mouse into ten other mice of the same species; with formation of cancer nodules in eight; which nodules were successfully used for further inoculation in yet other mice. More than this, he placed healthy mice in cages over a pan containing turpentine and camphor, by which they were kept free from insects, and remained in perfect health. In other cages he placed white mice with bedbugs taken from the cages of cancerous mice, and observed, after a few months, that all of the animals infested by these insects were suffering from cancer.

In view, therefore, of all these clinical considerations, the balance of this communication will be devoted to a consideration of the parasitic theory of cancer, and may, perhaps, be well prefaced by comparisons between cancer as we know it clinically and certain other universally acknowledged local and general infections. No safe inference can be drawn for or against the infectious nature of a given malady which is based solely upon a time limit. We have some infections, like those of bubonic plague, cholera, etc., which kill within a few hours, and thus present the most acute and distressing types of parasitic infection. There are others which require a few days, as tetanus, pneumonia, meningitis, and the like. There are yet others where the natural course of the disease takes one over a few weeks, such as typhoid fever. In yet others the disease requires at least a few months in which to run its course, as, for example, tuberculosis, save in exceptional instances. Syphilis and leprosy require, ordinarily, a few years before they would kill through their own ravages.

Thus it will be seen that there are time variations within the widest possible limits, and one does no violence to the theory

of parasitism if he accept the view that the infection which shall produce cancer may take a number of years to run its complete course.

Studying the subject from an historical stand-point, let us, with Roncali, divide the past few years, during which any careful observations have been made, into four periods, as follows:

1. Period of Inaccurate Observation and Erroneous Conclusions. This begins with Nepveau, who, in the year 1872, found microbes in epitheliomata. In 1886 Rappin, Scheurlen, Fraenkel, and others discovered cocci or other bacteria in malignant growths. In 1887 Scheurlen claimed to have discovered a specific organism, but his mistake was soon demonstrated. Besides Scheurlen, Ferrero, Schill, Perrin, Bernabei, Landerer, Maffucci, Babes, Kubassoff, Shattock and Ballance, as well as many others, recognized microbes in cancerous lesions, but failed to demonstrate their specificity.

2. Period of Accurate Observation and Inaccurate Conclusions. This is essentially the coccidial period. It began with the discovery, by Halle, Virchow, and Gubler, of protozoa in human tumors. These were subsequently assigned to the class of coccidia by a number of observers, among whom the names of Rivolta, Podwyssotzky, and Lindemann are best known. All of these observers became enthusiastic over, but were misled by, the well-known coccidiosis of the rabbit's liver. But there can be no doubt that the observers herewith mentioned observed parasites within and around cancer cells, though they were misled as to their nature. The most prominent of these investigators were D'Arcy Power, Fabre-Domergue, Duplay, Cazin, Török, Unna, Cornil, Kiener, Stroebe, Hlava, Obrzut, Pianese, Darier, Albarran, Malassez, Sjobring, Bouchard, Clarke, Kahane, Foà. Soudakewitsch, Podwyssotzky, Sawtschenko, Ruffer, Walker, and Vedeler. Of the correctness of their observations, at least in most cases, there can be no doubt; their mistake was in the interpretation of the phenomena. Nevertheless, the cell inclusions which they described were challenged by many other observers, who interpreted the phenomena in various ways.

Malassez regarded them as due to fatty degeneration; Tŏrŏk, Unna, and others spoke of colloid degeneration; corneous degeneration was held by Kiener, Domergue, and Petersen; mucoid degeneration was claimed by Hlava and Obrzut; Cornil and Kiener claimed a degeneration of nuclei in polynuclear cells; Virchow held to an endogenous degeneration; D'Arcy Power regarded them as abortive karyokinetic formations which had undergone a peculiar hydropic degeneration; while functional chromatolysis or other aberrant mitotic formations, or irregular vacuolization, as well as a great variety of other changes, were insisted on by various other students. This endless variety of opinion was of itself conclusive proof that the truth had not yet been reached. Moreover, culture experiments were complete failures.

3. Iconoclastic Period of Doubt as to the Accuracy of all Past Researches. This period began with Russell's work in 1890, and concluded with the researches of Banti and Nisser in 1894. Thus, Russell described certain round, homogeneous, structureless bodies which he found in groups within the tissues, as well as within the cells, and which he regarded as fungi. Banti found the same objects in Paget's disease, and Nisser isolated from the blood of cancer patients certain blastomycetæ, which he considered to be the actual parasites of cancer.

4. Period of Successful Inoculation, Practised for the Most Part by Italian Pathologists. The work of the Italians in this direction has been most creditable and apparently most convincing. It has been done for the most part by Professor Sanfelice, of the University of Cagliari, in Sardinia, and Professor Roncali, of the University Surgical Clinic in Rome. The former published his first paper on the subject in January, 1895, and the latter followed with his first only a month later. To these two men and their assistants we owe most of that which I shall epitomize below.

As the work of these Italians points, with a high degree of probability, toward the blastomycetæ as the active agents, it will be worth while to stop for a moment and rehearse the most

important facts known with regard to this class of fungi. It is best known as that to which the common yeast forms belong. These fungi reproduce themselves, not by division into halves, as do the common bacteria, but by the process of budding; the cells, when undergoing this process, appearing, under the lens, much like the common forms of cacti. Each bud provides itself with a membrane when separating from the parent cell, and thus becomes complete in itself. The parent cell does not die in this process, but gives rise to other buds, the entire process consuming about two hours in those forms where the life-history can be easily watched. This is slower cell division than occurs with the ordinary bacteria. The new cells thus produced are often bound together in clusters or irregular chains. Each cell has its proper membrane, which is filled with protoplasm, and contains a nucleus. It will average eight to ten millimetres in size. Under particularly favorable circumstances, spore-formation may also take place, so that from two to ten endospores may be seen in one parent cell. These spores are less resistant than those of the common bacteria. They are killed by five minutes' exposure to 62°-70° C. Those blastomycetæ which are capable of spore-formation are the least hardy, living in the ground for about a year, while others can live, under the same conditions, for three years. This is worth remembering, because there is much reason to think that these fugi are introduced into the system from the most common sources, and by the ordinary paths of infection.

They will grow on media which are slightly or strongly acid, and by this means can be separated from many of the common bacteria. Each species has its own peculiarity as to behavior respecting the various sugars. For example, by an ordinary wine yeast 1000 grammes of grape sugar were split up into 506 grammes of alcohol and 30 grammes of other products, including 21 grammes of glycerin. (By the way, the taste of various wines is quite perceptibly influenced by the amount of glycerin present therein.) Alcoholic fermentation can go on with or without access of air. If air be present, cell reproduction is more active, and other cell activity is lessened, and vice

versa. Acetic fermentation must be aërobic, butyric must be anaërobic; lactic fermentation and putrefaction are facultative aërobic actions.

So far as pathogenic activities are concerned, blastomycetæ are known to be active disease-agents in certain cases. They are commonly found in the urine of diabetic patients, but whether by accident or in some other relation is not positively known. Numerous forms have been cultivated and inoculated with resulting severe or even fatal symptoms—as in the morbid condition called saccharomycosis, which is known as an experimental disease. Thus it is established that a general infection from this cause is possible, and the question may arise whether general carcinomatosis is of this nature.

Now it is almost exclusively the blastomycetæ with which the Italians have worked, and have produced their remarkable experimental results, for they have found these organisms both within and between and around cancer cells, and have succeeded in making cultures in and upon acid media. Moreover, by inoculations with these cultures they have produced tumors in animals which bear the strongest possible resemblance to those neoplasms from which the cultures were originally made.

These parasites must be sought for in the periphery of the tumors and in the juices of the same, but not in the central portions, for here they often seem to have disappeared. This is true both of sections for microscopic examination and of the portions which are taken for inoculation purposes. Furthermore, most of the experimental tumors thus produced have returned the same blastomycetæ upon further culture tests. Two or three different forms have been definitely named by their discoverers; thus Sanfelice has described a saccharomycis lithogenes, and Roncali a blastomycis vitro-simile degenerans. These names both call attention to the remarkable properties which some of these fungi possess, not only of undergoing a rapid degeneration, but of displaying a peculiar calcareous deposit within the cell membrane, which is undoubtedly due to calcium carbonate, since, when these are treated with 4 per cent. solution of hydrochloric acid, the degeneration forms all disap-

pear—while, when treated with 4 per cent. sulphuric acid, crystals of calcium sulphate form. As showing also their marked tendency toward degeneration, Roncali placed two pieces of tumor in a Petri capsule, and kept it at 37° C. for four days. In the juices, the undegenerated forms were undoubtedly much more abundant than in the fresh specimens, which would indicate their truly parasitic nature.

As an illustration of the method of securing cultures, he prepared in one case sixty tubes of distilled water containing a little sugar and acid; in each of them he placed small bits of tumor cut with a sterilized knife. These were kept at 37° C. for ten days, when surface growths were found upon forty-seven of them, which, when examined in the hanging-drop, were easily recognized as blastomycetæ.

Sanfelice has produced small tumors in numerous of the smaller animals by injection of his saccharomycis above alluded to. It is most interesting also that some of the blastomycetæ which he discovered in tumors were identical with those found upon the common lemon, which grows so abundantly upon Italian soil. Among other experiments, he injected the saccharomycis into the mammary gland of a bitch, which lived for fourteen months and then died with a definite tumor in the gland and with metastases in various organs. Also, after injecting this culture into the abdomens of guinea-pigs, he saw them die in from twenty to forty days as the result of neoplastic lesions, while, when injected beneath the skin, it killed the animals in from thirty to fifty days, with local manifestations.

Thus, without quoting in detail the experimental labors of Sanfelice, Roncali, and their pupils, it may be stated as positively proven that the blastomycetæ above alluded to—*i. e.*, at least, some of them—are capable, first, of being isolated by culture methods from certain carcinomata and sarcomata; second, of identification as belonging among the yeasts; third, of producing tumors in animals by injection under suitable precautions, the resulting tumors being strikingly analogous to or identical with those from which the cultures were made; and,

fourth, of furnishing from these tumors further cultures, from which yet other experimental inoculations can be made.

Without going so far as to say that this can be done in every instance, or that all cancers are necessarily of parasitic origin, one is justified by these results in at least maintaining that some cancers are positively of such origin. If, upon this experimental ground, one should infer that all cancers are parasitic manifestations, he would do, as will be seen, little violence to the laws of logic.

Certain laboratory methods and precautions must be observed in these studies. The culture media must be distinctly acid in reaction. The blastomycetæ in question will grow in distilled water sufficiently acidified, to which a little sugar has been added, or in any of the ordinary media, provided only that they be sufficiently acid. I suppose that one reason why they have so long eluded detection in these locations is because neutral or alkaline media have been those generally employed. For inoculation, the distilled water above alluded to, or bouillon cultures, may be used with a hypodermic syringe, and the culture injected into a testicle or into the abdomen, or a small quantity of the culture from a solid medium may be inserted beneath the skin after making a small incision.

With these fungi, as with many other organisms, it is necessary often to do something to enhance their virulence before they become markedly pathogenic. Here we take advantage of an artificial symbiosis, and grow them upon the surface of a tetanus culture some eight or ten days old. In this way the desired augmentation of virulence is produced, the tetanus bacilli, being anaërobic, growing in the depths of the medium, while the fresh culture is planted upon its surface. Similar manipulation is often resorted to in the laboratory in connection with bacillus pyocyaneus and bacillus prodigiosus.

When it comes to the detection of these fungi in microscopic sections, the methods are more or less complicated, and require considerable training in special manipulation and observation. The directions are as follows:

Pieces of the tumor taken from the margin of the growth, or

at least from the outlying portions, are placed for ten minutes in a saturated solution of corrosive sublimate. The addition of a few drops of acetic acid while the pieces are immersed adds to the effect of the sublimate. After removal they are left for twenty-four hours in 60 per cent. alcohol, to which there is added ordinary tincture of iodine to remove the sublimate. It is added gradually until the solution ceases to be decolorized by decomposition. After this the pieces of tumor are hardened in strong alcohol in the usual way, cleared up in xylol and mounted in paraffin. From these small masses sections are cut as usual.

If one desire to stain the entire mass before cutting the sections, it is placed, after leaving the alcohol, for twenty-four hours in lithium carmine; then for twenty-four hours in alcohol containing ½ per cent. of hydrochloric acid. It is then hardened in alcohol and mounted as before.

When now the sections are cut, they are again freed from paraffin with xylol, treated with absolute alcohol, and left for from five to fifteen minutes in Ehrlich's fluid. After this they are washed in distilled water, put for five minutes in ½ per cent. solution of oxalic acid, washed again with distilled water, and then in absolute alcohol until it is no longer discolored. They are now cleared in xylol and mounted in balsam. Prepared in this way, the parasites are of a purple color, and the tissue is red.

The second method, which we owe to Sanfelice, consists in placing the sections for from ten to sixty minutes, or longer, in the following solution:

Saturated watery solution of safranine . . .	1 part.
Saturated alcoholic solution of malachite green . .	½ part.
Distilled water	½ part.

They are then washed in distilled water, decolorized by five minutes' immersion in ½ per cent. oxalic solution, washed again in water, then passed through alcohol and xylol and mounted in balsam. Prepared in this way, the parasites take a green or bluish-green color, while the protoplasm is red and

the nuclei safranine. Roncali suggests also the following solution:

Saturated watery solution of safranine . . .	5 or 6 parts.
Saturated alcoholic solution of gentian violet . .	1 part.
Distilled water	3 or 4 parts.

Sections are left from two to four minutes in this fluid, after which they are treated as above. Thus treated, the parasites assume a purple and the tissues a red color. This method has the advantage of saving time, but does not display the parasites to nearly as good advantage.

For much of the above information I am indebted to a personal acquaintance with Professor Roncali, from whom I secured my first cultures and illustrative slides. His writings on the subject have been numerous, and are mentioned below.

During a recent visit to Vienna I had also the advantage of noting what was being done in this line of research in the clinic of Professor Gussenbauer. Within the past year or so seven cases of melano-sarcoma have been carefully investigated by one of his assistants, with the result that from every case there has been isolated an anaërobic coccus which grows in ordinary media with a dark color. This color is not that which gives rise to the pigment of the active disease. This latter is due rather to a metamorphosed hæmoglobin which is known as melanine. Nevertheless, the coccus, growing *en masse*, assumes an almost brown or black color. Sufficient time had not elapsed when I last saw these cultures for experimentation, but it was proposed to inoculate them in horses, which are known to be peculiarly susceptible to melano-sarcoma.

Thus it will be seen that the problem of the nature of cancer, and, consequently, of its cure, is a most complicated one and must be studied from many sides.

The following list of papers and monographs pertaining to the subjects discussed in the above report is by no means complete, but will be found helpful by those studying the subject.

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REMEDIAL MEASURES IN OBSTRUCTION OF THE COMMON BILE-DUCT.

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Gentlemen: A paper upon the surgery of the gall-bladder and ducts was presented to the Southern Surgical and Gynecological Association at its meeting in St. Louis, and appears in the *Transactions* of that body. As a very full abstract of that article has been published by a number of medical journals, thus affording an opportunity for the Fellows of this Association to learn its contents, I may appropriately confine my attention on this occasion to the troubles growing out of obstruction to the common bile-duct.

It is not my purpose to consider the results of pressure upon the duct from tumors and growths outside of it, but to limit my investigation to inflammatory processes involving the coats of the common duct and to mechanical impediments to the free outlet of the bile into the duodenum.

There are certain spasmodic conditions, known as biliary colic, which are generally attributed to the passage of gall-stones, and which cease so soon as the calculus reaches the duodenum. It is evident also that many lesser derangements are connected with greater or less constriction of the common bile-duct from what is characterized as catarrhal inflammation of its walls, or doubtless in some instances from spasmodic conditions of the duct, independent of the presence of calculi in the canal.

The cases of jaundice which result from the temporary closure or constriction of the common duct are usually left to

the treatment of the physician, and yet are the precursors of derangements which require surgical interference, and hence come within the sphere of this paper.

They commence with functional disturbance, but terminate in organic derangement. Murphy lays great stress upon the relief of jaundice by pilocarpine as a means of distinguishing catarrhal obstruction from that caused by biliary calculi, and claims that the catarrhal inflammation is uniformly controlled by this method of treatment. In his article on "Obstruction of the Ductus Choledochus," in the *Twentieth Century Practice of Medicine*, page 761, he says,—

"To differentiate mechanical from catarrhal jaundice, it has been suggested that one-sixtieth of a grain of hydrochlorate of pilocarpine be given twice daily for two weeks."

If I am not mistaken, the reliance of the greater number of practitioners for relief in this class of cases has been, and continues to be, upon the phosphate of soda.

A very convenient form of dispensing this remedy is in solution, known as melachol, introduced by the Alta Pharmacal Company, of St. Louis. It has been employed with good effects in temporary interruption of the flow of bile from the gall-bladder, and may be given for several days with advantage.

In dealing with the formation of gallstones impacted in the common bile-duct, as well as collections in the gall-bladder, various medicines have been resorted to with benefit. But there have been more good results claimed from the employment of olive oil internally than from any other remedy of this class. There may have been some misapprehension in regard to the formation of spherical masses of fatty deposits with cholesterin in the evacuations from the bowels after taking large doses of olive oil. These balls are sometimes so solid as to be taken for calculi, but are readily crushed by pressure, and do not contain the elements of gallstones.

But genuine biliary calculi are often expelled by olive oil, and sometimes relief is permanent from this treatment.

I have resorted to this mode of relief in a considerable number of cases. Even when no gallstones were discovered, there

has been decided benefit from taking a pint of olive oil in four doses within twenty-four hours, and afterward two ounces night and morning for a week, with the use of an ounce at night for another week or two. This course of treatment has been followed by the use of, ℞: Fluid extract of taraxacum, f℥j; dilute muriatic acid, f℥ss; Fairchild's essence pepsin, f℥iv; in teaspoonful doses, three times a day, with a little water.

Such a combination improves the digestion by acting upon the liver and obviates biliary complications. So far as these measures effect any modifications of the structure, they may be recognized as surgical, and I would not exclude all medicinal treatment from the appliances which belong to the domain of surgery. We should not view operative procedures as the only recourse of the surgeon, and, while mere functional derangements pertain to the physician, those changes of the tissues which tend to organic or structural derangements belong to the sphere of the surgeon. The steps to be taken as prophylactic means or the measures adopted as preparatory to operative work are to be considered as surgical in their practical bearing upon the result of the case.

After exhausting medico-chirurgical means of treatment for biliary complications without arresting obstruction of the common bile-duct, the surgeon is confronted with conditions calling for operative interference. There may exist a stenosis or stricture of the walls of the duct, without occlusion of the canal, dependent upon inflammation; or there may be a partial obstruction of the lumen of the duct from the presence of a gallstone, which permits the bile to pass around it to a limited extent. In some cases Fenger has demonstrated that a gallstone may be so located as to form a valvular closure at times, and to drop back at other times into a larger portion of the duct, so as to leave a freer outlet for the bile into the duodenum, thus accounting for alterations in the appearance of jaundice.

The entire occlusion of the lumen of the common bile-duct, whether from adhesive inflammation of its walls or by the presence of biliary calculi in the canal, is ordinarily attended with

the absorption of bile into the general system and the absence of any bile in the intestinal canal. Under such conditions, the fecal evacuations are without the usual coloring matter of the bile and present a light clay color, while the urine has a deep tinge of bile, and is sometimes of a dark green or yellow hue.

The yellow tinge of the skin generally passes gradually into a deep bronze color, accompanied with great itching of the entire surface of the body. Digestion is much impaired, and cholæmia is marked by great lassitude and general vital depression, with despondency and mental hebetude.

The absence of the bile from the alimentary canal and the consequent deprivation of it in the digestive process accounts for the impairment of nutrition. But the further interference with assimilation is evident from the presence of bile in the various tissues, by absorption through the lymphatics, constituting cholæmia. The toxic properties of the bile when it is arrested in the ducts and gall-bladder, by an impediment in the common duct, are not so evident as when it enters the circulation and develops jaundice. Though an outlet may be artificially provided for the bile by connecting an opening in the gall-bladder with one in the abdominal wall, there is not always relief to the cholæmia, and its effects upon the general health of the patient continue, even to a fatal termination. It is the duty, therefore, of the surgeon to anticipate the grave consequences of obstruction of the common bile-duct by a timely resort to means of relief. In undertaking to make a diagnosis of the source of trouble in cases of the arrest of the flow of bile into the duodenum, the resort to an exploratory operation is often necessary, and the indication for this is generally clear by the presentation of a protuberance of the distended gall-bladder with or without enlargement and induration of the liver. The incision which is usually preferred extends from the outer margin of the right rectus muscle backward below the edge of the liver, parallel with the border of the costal cartilages and at a distance from this line depending upon the descent of the liver below the ribs.

In a case presenting no enlargement of the liver the incision

should be made on a line an inch and a half below the border of the costal cartilages, and should be about three inches in length through all the tissues of the abdominal wall. If the conditions of the structures require more space for examination, this incision may be extended at either end, and very rarely, if ever, is anything gained by a longitudinal incision in the line of the rectus muscle, as practised by some operators.

With this oblique opening into the abdominal cavity, the surgeon is enabled to explore all the region involved in trouble from obstruction of the common bile-duct, and to accomplish any operative procedure that may be required upon the ducts or upon the gall-bladder. The hand can be passed within this opening for palpation of the viscera, and most of the structures can be seen by the eye.

No reference is requisite to the mode of exploration by a trocar, which has been used by some operators for detecting stones in the gall-bladder or for drawing off its fluid contents preparatory to other operative procedures. I have elsewhere given an unfavorable opinion in regard to this exploratory puncture, and do not consider it entitled to recognition as a means of diagnosis or measure of treatment. An exploratory operation by a free incision may avoid the risks of such a puncture, and affords better facilities for information as to the further radical measures to be adopted in the case. Palpation of the gall-bladder and inspection of it will guide the operator as to evacuating its contents, while manipulation along the cystic and common ducts will detect any obstruction by biliary calculi or the agglutination of their walls by inflammation or distention by inspissated bile. This incision enabled me on one occasion to pass the hand within the abdomen and to lift the gall-bladder from the iliac fossa out of the opening, and on the same occasion to verify, by palpation from the other end of the incision, the occlusion of the common bile-duct near its entrance into the duodenum. It has the further advantage, by cutting through the tissues obliquely, of securing a better result from suture when closed, and thus being less liable to hernial protrusions than an incision in the *linea alba* or the *linea semilunaris*. I am

thus emphatic in preferring the oblique line below the costal cartilages in exploratory and other operations for trouble connected with obstruction of the bile-ducts from observation of its advantages over other modes of procedure adopted by some distinguished operators in this branch of surgery, and consider it essential for the best result.

The various measures recognized for the relief of obstruction of the common duct by gallstones are breaking up of the calculi by the needle, crushing by padded forceps, forcing them into the gall-bladder or duodenum, by catheterization, and excision through the walls of the duct.

Traction upon a calculus so as to bring it backward into the gall-bladder, from which it is to be removed by incision, is a procedure to be commended in cases when the stone is located near the opening of the cystic duct.

In the event none of these procedures prove successful in removing the impediment to the flow of bile into the duodenum, or it is found that impermeable agglutination of the walls of the common duct exists as a barrier to the biliary discharge by the natural channel, it then becomes requisite to provide an artificial outlet of the bile from the gall-bladder. In some cases it is impracticable to attach the gall-bladder to the parietal opening or to suture the incision in the wall of the duct when a stone is extracted, and thus it becomes necessary to provide for drainage by packing with gauze, around the field of operation, and leave the ends of the strips extending out of the wound.

It has been shown by Dr. W. E. B. Davis that this procedure proved satisfactory in his experiments upon dogs, and operators have had occasion to verify the advantages of this practice upon the human being when it was impracticable to effect drainage otherwise. While freshly secreted bile from a healthy liver has no septic property, there is evidently a hurtful effect of vitiated bile from a diseased liver, and hence it is desirable to carry it off by drainage.

In doing operations upon three white women for obstruction of the common bile-duct, by forming a fistulous opening for

the bile externally, the cholæmia persisted in an aggravated form until death supervened in each case. There was a free discharge of bile through the external orifice, but this did not afford relief to the dyscrasia and toxæmia resulting from the absorption of vitiated bile previously. It is true that a slight intoxication of jaundice from temporary obstruction of the common duct may disappear under medicinal treatment, and even profound cholæmia of short duration may be relieved by giving an external exit to the bile, but when the bile permeates the tissues and remains for a long time it becomes a poison to the system.

In some conditions of temporary impediment to the flow of bile through the duct into the duodenum, the attachment of the incised gall-bladder to the parietal opening has relieved the obstruction and been followed by the restoration of the bile to its natural channel.

It is held by some that, even when the occlusion is persistent, the escape of the bile by an external fistulous opening entails no serious consequences upon the health of the patient. But the bad result of the deprivation of the bile from the alimentary canal is a matter of common observation, and this condition of an external fistulous discharge is itself an urgent ground for operative interference to return the bile to the alimentary canal. As there seems to have been misapprehension on the part of some surgeons as to the claims of this measure of relief in obstruction of the common bile-duct, it is in order to state that only in complete occlusion of the duct, which has proved intractable to other procedures, has an artificial opening from the gall-bladder or the common bile-duct into the alimentary canal been thought proper.

It is begging the question to allege that any of the devices resorted to for the removal of stone or for the dilatation of the stenosis of the duct, with or without an external discharge of the bile through a fistulous opening, can take the place of a radical means of relief by attaching the gall-bladder to the duodenum or a coil of the small intestine. It is in cases not admitting of another recourse that cholecystenterostomy is indicated as a radical operation.

This anastomosis is effected in various ways, either with the duodenum, the small intestine, or the colon, the last-named being least desirable, as it fails to secure the advantages of the bile in the process of intestinal digestion. My experiments upon dogs demonstrated the feasibility of this fistulous communication of the gall-bladder with the bowels, and it is a matter of minor importance by what process it is accomplished. It is no part of my undertaking to set forth any special technique for securing the end in view, of connecting the gall-bladder or the common duct with the alimentary canal so as to admit of the passage of the bile into the latter. My own aim has been to place the operation of cholecystenterostomy on the basis of a life-saving operation when all other means are found to be fruitless in cases of complete occlusion of the common bile-duct.

Some prominent surgeons, and most conspicuously Tait, of Birmingham, have ignored or condemned this radical means of relief, but a sufficient number of successful results have crowned the operations of equally distinguished members of the profession to offset any mere speculative opinions adverse to it. If I have been instrumental in directing attention to this procedure as the sole agency in correcting an otherwise irremediable condition of things connected with occlusion of the common bile-duct, I ought to rest satisfied with the result.

The statistics in the past show that the various modes of procedure are comparatively free from danger and are attended with a marked degree of success, so that we may reasonably expect cholecystenterostomy to be recognized as a safe and efficacious recourse in the future annals of surgery.

From the foregoing considerations we make the following inferences:

1. That obstruction of the common bile-duct may result to a greater or less extent from catarrhal inflammation or from gall-stones.

2. The ordinary accompaniments of any obstruction of the common bile-duct are jaundice and the absence of the usual color in the fecal evacuations.

3. In the lesser developments of jaundice medication is to be relied on for relief, but in the more accentuated and persistent forms operative measures are always requisite.

4. An exploratory operation by incision diagonally beneath the right costal cartilages enables the operator to determine upon the nature of the impediment and the best means of relief.

5. In the various cases we may resort to catheterization, needling, crushing, traction, incision of duct or gall-bladder, with attachment of either to the parietes or intestine.

6. That complete occlusion of the common duct cannot be remedied by the outlet of bile through a parietal opening, but calls for a communication of the gall-bladder or the duct with the intestinal canal.

7. The duodenum affords most favorable conditions for this connection, a coil of small intestine comes next in its advantage, and the colon presents least benefits, as it fails to obtain the good effects of the bile for intestinal digestion.

8. The anastomosis of the biliary system with the alimentary canal may be accomplished by different processes, and the selection of the mode best adapted to the case may be left to the choice of the operator.

9. Permanent occlusion of the common duct, associated with a patulous cystic duct, is the only condition in which cholecystenterostomy is indicated, and for this condition of things it may be considered a radical mode of relief.

10. While a fistulous communication of the gall-bladder or common duct with the alimentary canal is a safe and efficacious mode of relief for all ordinary results of occlusion, it does not afford exemption from the consequences of malignant growth, and hence this kind of obstruction is not included in this paper.

TRAUMATIC RUPTURE OF PANCREAS; FORMATION OF HEMORRHAGIC CYST; OPERATION; PANCREATIC FISTULA; RECOVERY.

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I HAVE found very few published reports of recovery after crushing and rupture of the pancreas. Opportunities to investigate the pancreatic secretion in cases of pancreatic fistulæ in the human subject are also very rare. The clinical symptoms which indicate a pancreatic lesion are not well known, and its diagnosis is still difficult and uncertain. Positive knowledge of its physiological processes is limited. I, therefore, present the following record hoping it may be of interest.

About December 9, 1896, a well-developed, medium-sized man, aged thirty-one years, whose hereditary and previous history indicated a perfectly well person, was injured as follows: About 5 P.M., while at work in a piano factory, he was struck in the epigastric region by the end of a board. This board was four feet long, nine inches wide, and one inch thick. It fell accidentally upon a rapidly revolving circular saw, and was thrown violently against the patient. The result was a sudden, violent blow in the epigastrium, five hours after eating. He fell on the floor. Did not quite lose consciousness, but felt great depression, faintness, pain, and distress.[1] Was removed to his home in a carriage. Distress and severe pain in epigastrium continued. He did not go to bed till 11 P.M., at which time he vomited profusely. The vomitus was described as containing dark clotted blood in considerable amount. This hæmatemesis recurred once on the next day, but not afterward. He remained in bed one week, during which time

[1] Shortly after the injury had great pain in right cervical region, and head was drawn to right. This condition of torticollis lasted two days and caused great discomfort, then completely disappeared. Severe pain was also felt, shortly after the injury, in the left chest over the cardiac area. This lasted six to seven hours.

the epigastric pain and nausea continued. It was increased by food. Food also caused vomiting. No dejection without cathartics. At the end of the week he attempted to get up, as the symptoms were then somewhat relieved, and go about; but at the end of three days the recurring vomiting, discomfort, and epigastric pain again forced him to go to bed. The vomitus was greenish. The pain was throbbing in character. A few days later another attempt was made to get up, but the pain, vomiting, and distress soon obliged him to return to bed. Two weeks after the injury a painful, pulsating, somewhat tender tumor in the right epigastrium was noticed, which increased rapidly in size.

No especial constitutional disturbance was reported. There were no thoracic symptoms. The dejecta and urine did not attract attention.

The next event noted (about January 7, 1897) was pain, tenderness, and marked swelling in the left parotid, region with dysphagia A few days later the right parotid became swollen, painful, and tender, but not so much so as the left.

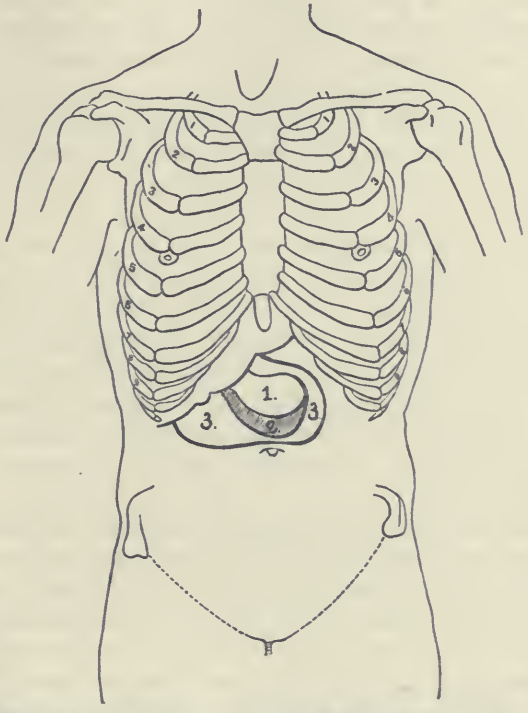
This state of affairs continued till January 9, 1897, when the writer first saw the patient. The symptoms were still throbbing epigastric pain,[1] pain in lumbar region, vomiting. Micturition was somewhat painful. No dejection for three days. The face showed some emaciation. The expression was somewhat anxious. Temperature, 100.2°; pulse, 114. Tongue dry, with rather thick brown coat. The left parotid gland was considerably swollen and tender. The right parotid was similarly affected but to a less degree. There was dysphagia. Thorax negative. Abdomen: There was a slight, recently healed, apparently superficial wound over the tip of the ninth right costal cartilage, probably made by one corner of the board. In the epigastric region the surface was slightly elevated, especially to right of linea alba. The swelling extended into the left hypochondrium. About the middle third of the distance from the xyphoid cartilage to the umbilicus was an area which visibly pulsated. It was rather resonant with light percussion, but flat when percussed more forcibly.

It was somewhat resistant to palpation, and a smooth elastic mass was felt, whose exact outline could not be determined. It was not movable with gentle manipulation. It was somewhat tender. It pulsated distinctly and the pulsation was apparently expansile. Its size

[1] The pain was more or less constant, worse after eating, and increased by motion. When at rest the patient was fairly comfortable.

was about three inches vertically and four and a half inches horizontally. Auscultation was negative. Pulsation in the femoral arteries at Poupart's ligament was equal, synchronous, and apparently not delayed. The hepatic dulness extended in front below the right costal border. Abdomen otherwise normal. The examination of the urine was negative.

FIG. 1.



1. Area of flatness, January 9th. 2. Area of flatness, January 10th. 3. Area of flatness, January 15th.

The most probable explanation of the patient's condition seemed to be that the abdominal wall when struck had yielded, allowing the contents of the abdomen at the point of impact to be crushed between the end of the board and the spine. Its elasticity saved it from injury, except the slight superficial wound above described. The bloody vomitus was thought to indicate a contusion of the stomach. The throbbing epigastric pain, the epigastric tumor first

noticed two weeks after the injury, increasing in size, with its apparent expansile pulsation both seen and felt, its smooth, elastic surface, and flat percussion note seemed to indicate a traumatic aneurism of some branch of the cœliac axis. There was no satisfactory explanation for the condition of the parotid glands.

After a careful consideration of the case it was thought most judicious to watch the effect of conservative treatment.[1] This was done for one week (until January 16th). During this time the patient's general condition improved. The tongue became cleaner, the temperature normal, pulse 85 to 98. The swelling of the parotids was diminished and the dysphagia had disappeared. But the abdominal subjective symptoms were unchanged. The epigastric pain continued to be variable. It was more marked with dorsal decubitus—and after eating. It was still throbbing in character. The tenderness was unchanged.

Food by mouth had to be discontinued on January 11th, on account of the pain and vomiting caused by it, and the patient was fed by enemata. The condition of the abdomen had altered. The recti muscles were more tense. The tumor had increased (Fig. 1, 3) in size. The swelling in the right epigastric region was now plainly visible. The area of flatness on deep percussion was increasing and changing in contour. The tumor moved with respiration. The pulsation was less marked. The superficial inferior epigastric veins had become dilated.

Briefly, although the patient's general condition and parotid complication were improved, the abdominal symptoms were not relieved. The tumor was rapidly increasing in size, and threatened to endanger the patient's life. Rectal feeding was not a satisfactory manner of nourishing a patient critically ill. The patient earnestly requested operative treatment. An operation was therefore decided upon and performed on January 16th, thirty-eight days after the injury.

Operation.[2] The abdomen was opened in the median line.[3] The

[1] Rest in bed, careful feeding, hot fomentations to abdomen and parotids, systematic treatment of subjective symptoms with drugs indicated.

[2] Anæsthetic: ether. The operation was performed as far as possible under aseptic conditions. Preparation of patient: Fürbringer method. Hands: "Permanganate-oxalic" method. Materials (gowns, sheets, dressings, etc.), sterile by steam under pressure "in vacuo"—fractional sterilization. Instruments, ligatures, sutures, and utensils: Schimmelbusch method.

[3] The incision in the linea alba was five inches long, passed the umbilicus slightly to the left, and extended four inches above and one inch below it.

transverse colon and omentum appeared. The colon appeared to lie superficially to the tumor, which was about five inches in diameter. In order to locate it more definitely an attempt was made to raise the great omentum. This showed some ecchymotic areas and was quite adherent. It was separated with great difficulty, and when raised exposed the tumor bulging out below the transverse colon—dark reddish-blue in color, and fluctuating. On account of its site when first noticed and its present position, a vertical incision was made between the stomach and transverse colon apparently into the cavity of the lesser omentum. A large quantity of fluid escaped (at first clear, watery, and straw-colored, later stained reddish brown), leaving an irregular cyst-like cavity five inches in its antero-posterior diameter. On digital examination the finger came directly upon the aorta, showing that the fluid was retroperitoneal and not in the cavity of the lesser omentum. A little below, a somewhat granular, rather firm mass was felt, resembling in position and outline the pancreas. To the right of the median line toward the duodenum was a ragged irregular cleft which readily admitted the finger, but the depth of the cavity and the blood present prevented its being actually seen. No vessel sufficiently large to require ligation was seen. The operation had apparently demonstrated a wound or rupture of the pancreas near the omental tubercle and not an aneurism. The patient's condition was now such that it was unsafe to prolong the operation. It was therefore finished as rapidly as possible. The cavity was packed with iodoform gauze to control hemorrhage and provide drainage. The edges of the wound in the omentum, between the stomach and the colon, were sutured to the edges of the parietal peritoneum, thus closing off the general peritoneal cavity. The abdominal wound was closed by silk sutures, except at point of emergence of gauze strips, and was dressed with a large sterile gauze dressing, sheet cotton and swathe. The duration of the operation was an hour. Considerable shock followed.

January 17th. Patient weak, slight vomiting. Profuse sero-sanguinolent discharge from the wound, which, necessitated a new dressing six to eight hours after the operation. Cough. Respiration 36; temperature 102.4°; pulse 129. Rectal feeding.

18*th.* Much worse. Condition alarming, due apparently to an abscess, which, fortunately, was evacuated spontaneously through a bronchus. The discharge from the wound was so profuse as to saturate

completely a sterile gauze and cotton dressing large enough to cover the abdomen and three inches thick, once in eight hours.[1]

19*th*. From this point patient began to improve. He gained strength rapidly. On the 20th temperature, pulse, and respiration were comparatively normal. Vomiting had ceased and feeding by the mouth was begun. On the 22d the patient was eating selected solid food. The expectoration was slight only on the 21st, and ceased on the 25th.[2] The cough was slight on the 21st, and ceased on the 29th. The physical signs in the right chest also rapidly and entirely disappeared. The condition of the parotids steadily improved, the tenderness disappeared and the swelling diminished gradually. On February 13th the right was normal. The left showed only an indurated mass, one inch long, subjacent to the angle of the jaw, which soon disappeared. The operation wound healed rapidly to the point of drainage. In spite of frequent dressings and the profuse discharge,

[1] This diagnosis was made from the following symptoms: The temperature, pulse and respiration curves. A severe cough. Sudden expectoration of a large amount of foul-smelling muco-purulent expectoration. Hepatic area of dulness lower than normal. Dulness in lower right chest with diminished respiration, vocal resonance, fremitus, and coarse moist râles. In the above area a smaller area at the base of the lung two inches by three inches, which was flat, with respiration, voice sounds, and fremitus nearly absent.

[2]

1897		Temperature		Pulse.		Respiration	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
January 10	2	100.4	99.4	115	110		
" 11	3	99.6	99.6	98	110		
" 12	4	99.4	99.4	100	98		
" 13	5	99.5	100	95	94		
" 14	6	98	98.2	95	98		
" 15	7	98.4	98	98	84		
" 16	8	97.8	100.2	86	120	Operation.	
" 17	9	98	102.4	119	122		
" 18	10	98	103.4	118	122		36
" 19	11	98.2	98.2	118	105	35	25
" 20	12	98.3	98.5	115	108	20	25
" 21	13	98.5	99.2	97	105	21	24
" 22	14	99	99.2	100	90	24	23
" 23	15	99	98	94	102	23	24
" 24	16	98.6	98	92	102	24	26
" 25	17	98	98	96	105	25	22
" 26	18	98.2	99	96	104	25	23

From January 26th to March 1st the temperature was practically normal. The pulse averaged 95 to 100 till February 24th, then ranged between 80 and 90. The respiration was 25 as long as it was recorded (March 3d).

it was kept almost entirely free from suppuration. The peritoneal edges united firmly, shutting off the general peritoneal cavity. The packing of iodoform gauze was removed on January 21st, and replaced by sterile gauze strips. The sutures were removed on the 24th. The cavity of the cyst rapidly contracted. From a diameter of five inches at the time of the operation on the 29th, its capacity was barely eight c.cm., and on February 6th it was a sinus (four cm. long and one-half cm. in diameter) in which a drainage-tube was retained with difficulty. On February 12th the tube was discontinued. The patient sat up on the 11th; walked on the 13th; was dressed and about on the 18th; and on April 15, 1897, eighty-eight days after the operation, returned to work and his former daily life.

The above facts complete the history of the case except in one particular, which is unusual and interesting.

It was noticed at once after the operation that the amount of discharge from the wound was excessive, at first like bloody serum, but in a day or two clear. On January 21st the skin in the vicinity of the wound showed distinct signs of irritation. The itching and burning caused marked discomfort. The iodoform gauze (a possible cause) was therefore discontinued, but without relief. The condition increased so that on January 24th the entire upper abdominal and lower thoracic regions were denuded of epidermis, as if removed by erosion Wherever the discharge came in contact with the unprotected skin it caused great itching, burning, and smarting, and rapidly removed the epidermis. The most probable explanation of this excessively irritating discharge was that it was pancreatic secretion, and efforts were made to establish its identity. The information at the writer's disposal and his own knowledge, based wholly on general pancreatic literature, led him to expect that in affections of this organ the clinical picture would show rapid emaciation; frequent dejections, containing much undigested fat, starch, and some muscle fibre; a pale, dirty-yellow skin, and sugar in the urine. Normal active pancreatic fluid is described as a slightly turbid, somewhat viscid fluid, which resembles saliva, frothing on agitation, distinctly alkaline. Specific gravity 1030. Albumin as an alkaline albumin, sometimes leucin or tyrosin. It should emulsify fats, digest proteids or fibrins, and transform starch to glucose. Its amount in twenty-four hours, about 300 to 400 c.c. That in pancreatic fistulæ in animals the secretion soon loses its specific characteristics. With this description the clinical picture of this patient does not wholly correspond.

At first there was considerable emaciation, but after January 25th this rapidly disappeared. It would have been strange if it had not occurred even had there been no deficiency of pancreatic digestion. A severe injury, several weeks of suffering, a severe operation, and a pulmonary or subphrenic abscess would easily cause it. The urine never contained sugar.[1] There was no diarrhœa. The feces were practically normal, or, at least, showed only slight intestinal irritation. There was no starch in any amount, only a small amount of fat, some undigested muscle fibre, epithelial cells, detritus, and pus (microscopically only). The patient was not especially pale or yellow. The discharge was profuse, and, if pancreatic fluid, one would expect that most of the total amount must have escaped and so unavailable for digestion. It, thereupon, seemed probable that this deficiency would soon show itself, and the prognosis for the patient under such conditions be a grave one. But, so far as the patient's general condition or digestive processes were concerned, this profuse loss of secretion appeared to have no effect. The examination of the fluid previous to February 6th did not positively demonstrate that the fluid was from the pancreas, the physiological reactions being negative, although it resembled it in several other particulars.[2]

It was not until February 6th, when, with the valuable co-operation of Dr. Franz Pfaff,[3] a more careful and extended examination was begun, that the fluid was shown beyond doubt to be pancreatic. This

[1] There is no record previous to the time when the writer first saw the patient (thirty-one days after the injury), but frequent examinations after that were always negative.

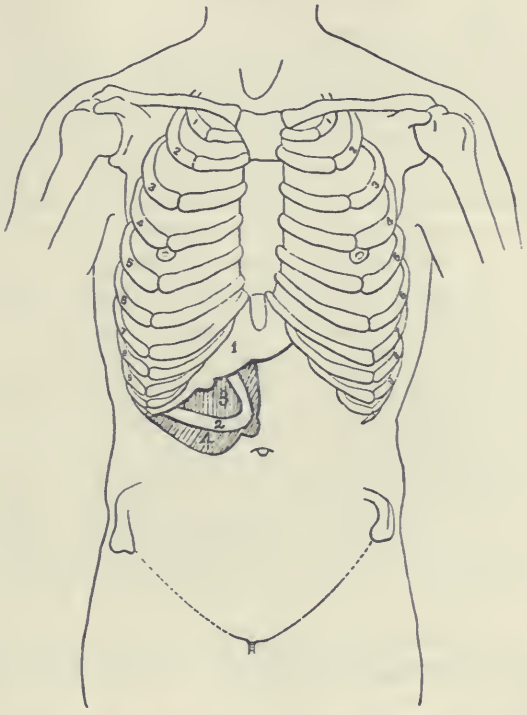
[2] Summary of analyses made at Pathological Laboratory of Boston City Hospital: with the assistance of Drs. J. B. Ogden, F. B. Mallory, and S. T. Leary: Amount; twenty-four hours not known, quite large, 500 c.cm. at least. Color: Slightly turbid, like saliva or watery solution of white of egg; clear after filtration, like water. Strongly alkaline Specific gravity 1011. Flows rather freely. Slightly viscid, froths easily on agitation. Odor: None, or slight; resembling an alkaline hydrate. Chlorides: Slightly diminished as compared with urine. Albumin: Proteid, HNO_3 test, one-eighth per cent. approximately, consists chiefly of albumose peptonized by $(NH_4)_2SO_4$ saturated solution. Serum albumin: Heat test, very slight trace. Peptones: None. Serum globulin: None. Albumates: Acid, none; alkaline, none Sugar: None, Fehling's solution and other tests. Bile: None. Digestive tests: Fibrin, negative; starch, negative; fat, negative. Sediment: Considerable (forms on standing by coagulation of a partly amorphous material); contains some leucocytes and a few blood-globules; some small, round, fatty degenerated cells, slightly larger than blood-corpuscles. No pancreatic cells. Above probably from tissue during process of healing, *i. e.*, operation wound.

[3] Pharmacological Laboratory of the Harvard Medical School.

showed conclusively that the fistula was connected with the pancreas.[1]

The local conditions up to this time were epigastric pain and tenderness on stooping; the abdomen normal in contour, with no induration; an area of dulness (which changed subsequently), as in Fig. 2, and the extensive erosion of the epidermis from the discharge.

FIG. 2.



1. Area of dulness, February 7th. 2. Area of dulness, February 8th. 3. Area of dulness, February 13th. 4. Area of dulness, February 20th. 5. Area of dulness, February 21st (same as 2). 6. Area of dulness, February, 23d (same as 3).

[1] Dr. Pfaff's analysis of the fluid was: Amount: 500 to 660 c.cm. in twenty-four hours. Color: Watery solution of white of egg, opalescent, strongly alkaline. Specific gravity: 1011. Sediment: Very slight, no definite organic elements. Boiling produced flocculi of coagulated proteids. Starch was changed to glucose. Neutral fats were split into fat acids and glycerin. Blood fibrin was digested with formation of peptones. The action of the ferments was quite marked with the fresh fluid.

The discharge from the sinus was continual drop by drop. It was most rapid about three hours after eating, and diminished during the night. Total amount in twenty-four hours still large. The area of dulness steadily diminished until February 20th, then suddenly increased considerably. (Fig. 2, 4.)

This was immediately preceded by a marked diminution in the amount of discharge from the sinus. The next day the discharge began to flow again, and the dulness steadily diminished. On March 1st it was absent.

On February 21st, by means of a "Pegram" tube,[1] the sinus was so drained that almost the entire amount of the discharge could be collected and the patient kept quite dry. This furnished a satisfactory opportunity to estimate the rate of flow and an abundant supply of fluid for examination. It was a most efficient way for controlling the sinus. It was worn until the discharge had almost ceased, on March 31st, when it was removed. The remaining sinus healed in four days (April 4th), seventy-seven days after the operation. From this time, except for some epigastric tenderness and pain on stooping, due probably to pressure on the pancreas, the patient was well.

The subsequent history to the present time, March, 1898, is that the patient has done well. A ventral hernia at the site of the operation wound, due to a separation of the recti muscles, was noticed on April 23d, 1897, and is still present, requiring a truss bandage. There is, at times, some pain deep in the abdomen under the tip of the right twelfth rib. There is no functional disturbance of the alimentary canal. With the exception of the hernia the abdominal examination is at present negative. The patient's general condition is excellent.

Cases of pancreatic fistulæ have occurred. I have not been able to make any special addition to the extensive bibliography

[1] An appliance devised by Dr. John C. Pegram, Jr., for permanent drainage of a biliary fistula. It consists of a rubber tube with rather rigid walls, having a diameter a little less than the diameter of the fistula. One to two inches of that portion of the tube which is just internal to the skin is increased in diameter by covering it with a section of a larger tube. To fit this tube the sinus is dilated, and the tube inserted until the increased diameter is just inside the skin. In a few days the orifice of the sinus contracts firmly about the tube and holds it in place. By a section of glass tube the Pegram tube can be connected with a rubber tube, and the discharge from the fistula drained into a bottle. It is an efficient means of draining a fistula when it is necessary to protect the skin or a dressing from the discharge.

of pancreatic lesions published by Prof. Senn.[1] I have been able to collect from the literature of the pancreas only nine cases whose character is of interest here. Four[2] died at once from multiple injuries, the pancreas being extensively crushed. Two[3] were cases of cysts caused by traumatism (a crushing injury or a blow), and three[4] cysts with no history of injury. Of the five cysts all were operated upon. All recovered. In all fistulæ resulted. In three the fistulæ healed in two to four months. In two I am ignorant of the final result. In none were any investigations reported, except the tests to show the character of the fluid. Neither Dr. Pfaff nor I know of any other case except the one now reported in which observations have been made to establish the daily amount of the secretion of the pancreas. I will not delay here to describe Dr. Pfaff's extensive and valuable work, which he has in part already published.[5] I will only briefly state a few results.

He found that the fluid when fresh gave promptly the three physiological reactions which established its identity without doubt. By means of the "Pegram" tube probably not more than 15 to 20 c.cm. of the fluid from the fistula was lost in twenty-four hours, so that fairly accurate continuous measurement by hours could be made. By making such measurements continuously for forty-eight hours it was possible to form a curve showing the rate of secretion and the effect of food on glandular activity. This curve (Fig. 3) shows variations between 6 and 60 c.cm. in the amount of secretion per hour, the maximum amount being in the daytime during digestion, and the minimum during the night. The variations correspond to those of the biliary secretion. This is shown by this curve, which was

[1] Reference Handbook of Medical Sciences, vol. v. p. 488.

[2] Travers: Lancet, 1827, vol. xii. p. 384. Störck: Annus Medicus, 1836, p. 244. Cooper: Lancet, 1839, vol. i. p. 486. Clark: Lectures on Principles of Surgery and Diagnosis, 1870, p. 298.

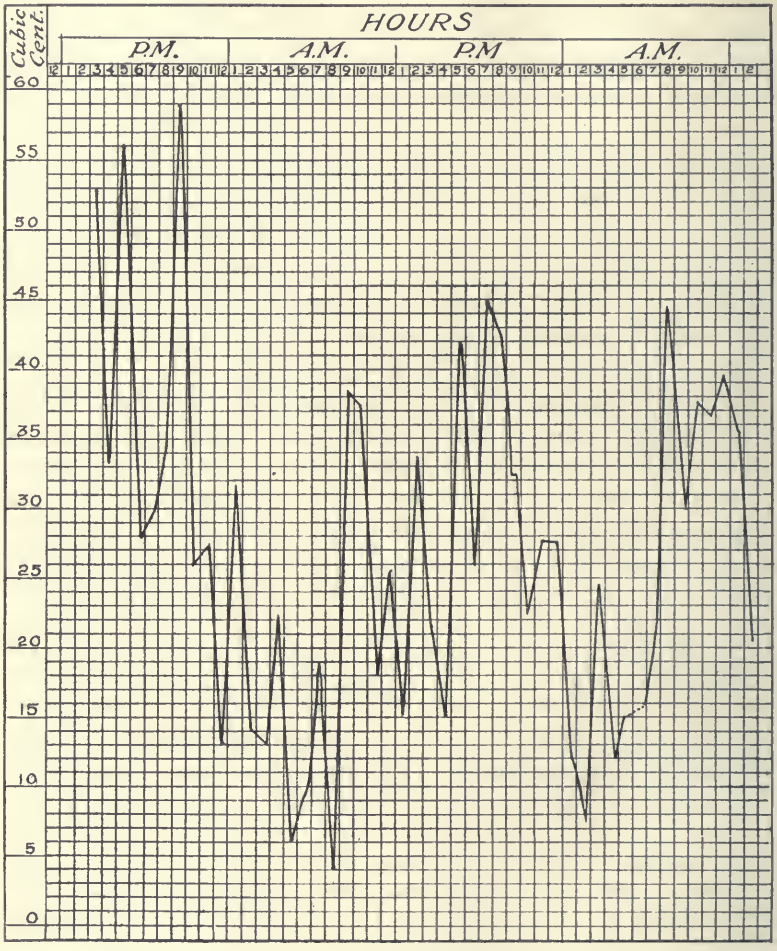
[3] Senn: Journal American Medical Association, 1885. Kulenkampff: Berliner klin. Wochenschrift, 1882.

[4] Gussenbauer: Archiv f. klin. Chir., vol. xxix. p. 355. Thiersch: Berliner klin. Wochenschrift, 1881. Kramer and Hahn: Centralblt. f. Chir., 1885.

[5] Science, June 11, 1897. Journal Boston Society of Medical Sciences Nov., 1897.

also compiled by Dr. Pfaff, in a similar manner, from observations made by him on a patient with a biliary fistula and com-

FIG. 3.

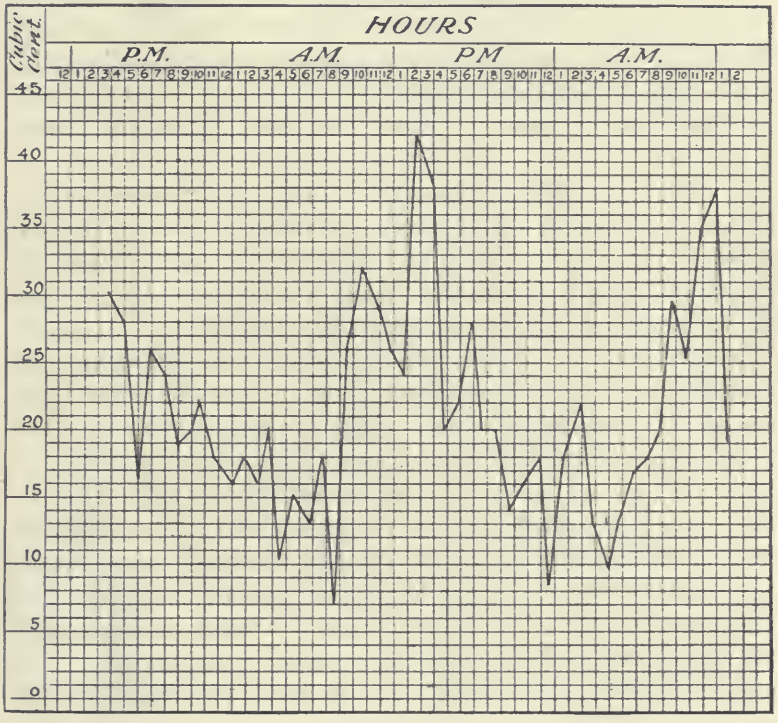


Pancreatic curve.

plete occlusion of the common bile-duct. The total daily amount of pancreatic secretion was measured for thirty-three

days. The amount usually stated in text-books of physiology (which is based mostly on the results of experiments on animals) is 250 to 350 c.cm. in twenty-four hours. For eight consecutive days the total daily amount from this patient was found to be 500 to 660 c.cm., or double the above. Also it was noted

FIG. 4.



Biliary curve.

that, although the patient ate a mixed diet and that daily over 600 c.cm. of fluid escaped from the fistula, still the feces were normal in character and amount and no excess of fat or starch in any quantity could be detected. Therefore, part of the pancreatic secretion, enough to carry on digestion, must have passed into the intestine, and the fistula was an incomplete one.

When, in addition to the above amount, one remembers that 500 to 600 c.cm. of fluid were collected daily from the fistula, it would seem to indicate that the capability of the pancreas for the secretion of digestive fluid is much greater than has been heretofore assumed by physiologists.

At first, the urine was considerably increased in amount.[1] There was no sugar or albumin. Later the amount varied between 1350 c.cm. (45 ounces) and 1800 c.cm. (60 ounces), being normal in other respects. This condition was probably due to the increased metabolism while the patient was improving rapidly during convalescence.

When one reviews the above case certain features attract attention.

1. *Diagnosis.* What does this record show which indicates a lesion of the pancreas? It shows that when a blow or crush is received in the epigastrium followed by continued epigastric pain, increased by food, vomiting, and the appearance of a tumor which, at first, is situated over some part of the pancreas, which grows rapidly, which percussion or inflation of the stomach and transverse colon shows to be subjacent to these viscera, it is probably a case of injury to the pancreas. The tumor may pulsate, and it may, when large, move with respiration. If there is present from wound or fistula an alkaline fluid which digests the epidermis and which gives the three characteristic physiological reactions with starch, blood fibrin, and neutral fats, its source is the pancreas. The absence of starch or fat in the feces in abnormal amounts, or of sugar in the urine, does not show that the pancreas is unaffected. Such a tumor as was present in this case must be distinguished from an abdominal aneurism, pyo- or hydronephrosis, echinococcus cyst, a cyst of the suprarenal capsule.

2. How can one explain the affection of the parotids? I do not know. It is stated by Grieg Smith,[2] Paget,[3] Goodell,[4]

[1] February 24, 1897. 2400 c.cm. Specific gravity 1014 U. 61.3 N. 26.4
" 25, 1897. 3300 " " " 1015 U. 63.3 N. 26.7
March 9, 1897. 1880 " " " 1016 U. 40.8 N. 18.07

[2] J. Greig Smith: Abdominal Surgery, p. 98 and Bibliography.

[3] Paget: Lancet, 1886, p. 86.

[4] Goodell: Transactions American Gynecological Society, 1886, x. p. 211.

Keith,[1] Bumm,[2] Bougarel,[3] *et al.*, that after injuries and operations on the abdominal organs in a small proportion of cases a non-suppurative parotiditis occurs which is attributed to reflex irritation or "sympathy" in some way. The idea is theoretical only. Another possibility, suggested to me by the normal action of the parotid secretion on starch, and which is similar (though less in degree) in this respect to the action of the pancreatic fluid, is that the parotid enlargement was the result of an attempt at vicarious function on the part of that gland.

3. Was there any connection between the injury to the pancreas and the torticollis which was noticed almost immediately after the injury and which lasted forty-eight hours? After considerable investigation I am unable to give a positive answer. It may have occurred from a sudden muscular action or wrench of the neck at the time of the injury and have been wholly connected with the pancreatic lesion. Muscular spasm, aside from distinct local causes accompanied by pain, usually indicates nerve irritation at some point in the nerve trunk supplying the affected muscles. One, therefore, seeks a nervous connection between these cervical muscles and the seat of primary injury in the epigastrium. These are the phrenic, pneumogastric, and sympathetic. I am unable to demonstrate definitely any such nervous connection, and cannot, therefore, explain the condition as a case of reflex nerve irritation.

4. What was the cause of the abscess which evacuated itself through the lung just after the operation? The physical signs in the right chest enable one to eliminate an empyema unless quite circumscribed. There remains to consider a pulmonary or subphrenic abscess, and when one considers that the stomach was probably injured (vomiting of blood after injury, etc.), the site of the blow, the absence of symptoms of lung irritation (cough, expectoration, etc.) till the abscess was evacuated, and the depressed liver, it seems more probable that the infection

[1] Keith: Edinburgh Medical Journal, 1886, vol. xxxii. p. 306.
[2] Bumm: Centralblt. f. Gynäk., 1887, vol. xl.
[3] Bougarel: France Méd., 1886, vol. ii. 1232.

had its origin from the wound of the stomach, and that the collection of pus originated below the diaphragm. It was a very dangerous complication which had a very fortunate ending.

5. The erosive action of the pancreatic fluid on the skin. It was striking as a diagnostic characteristic of pancreatic fluid. The patient was especially interested in finding something to check its action and prevent it from skinning him alive. It caused him more discomfort than any other thing, the pancreatic lesion even included.[1] It is hard to understand why the fluid digests epidermis and not granulation tissue or peritoneum. The most plausible explanation that I know is that the latter are living vascular tissues, while the epidermis is composed of cells with practically no vitality.

6. Before concluding I wish to allude to the method of drainage of the pancreatic fistula which was finally employed, and was of such striking efficiency as to deserve mention. This was the "Pegram" tube already alluded to. After it was inserted the patient was kept nearly dry. Almost all the fluid from the fistula could be easily collected and prevented from coming in contact with the patient's skin or the dressing. Similar tubes can be adapted to other varieties of fistulæ to advantage. It has been used with success with biliary fistulæ, and for such a fistula it was originally devised.

7. By comparing the daily amount of fluid from the fistula with the clinical symptoms it was noted, on three occasions when the amount of discharge diminished to any degree, and especially when the fistula finally closed, that there were symp-

[1] The skin was protected with great difficulty. The discharge was so profuse that all protective powders, *e.g.*, stearate of Zn. starch, Zn oxide, bismuth, et al., also ointments of all kinds, were soon washed off. Applications of collodion and similar preparations simply kept the fluid in contact with the skin, for it at once undermined the layer, and wherever it touched the epidermis was soon digested off, leaving a very sensitive surface. This was a source of greater discomfort than the operation. Attempts to chemically neutralize the fluid with the common vegetable or mineral acids were futile. After much experimenting, the patient was finally relieved by painting the abdomen with compound tincture of benzoin, and after this the skin healed rapidly and there was no more trouble as long as it was thus protected.

toms of intestinal, irritation shown by discomfort, gas, and frequent loose dejections (three or four in twenty-four hours) containing mucus.

8. An unusual appetite or craving for bread was present for a time. Also, for a few days after the operation, a marked desire for acids.

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

This case is very interesting because of its rarity. I have myself had one case of pancreatic cyst which did not arise from injury, but occurred spontaneously. I was not able in my case to make any measurement of the amount of fluid discharged, partly because I was uncertain whether all the fluid would pass through the opening or a part would escape into the bowel, and partly because I was not sure that any really valuable information could be obtained from such imperfect data. However, I did determine by chemical tests that it was pancreatic fluid. There was no wasting of the patient, no sugar in the urine, nor any fatty stools. I think the observations that have been made in this case are worthy of all commendation, and I congratulate Dr. Cushing in making such a valuable investigation. In a number of the cases recorded before mine it was shown that, as a general rule, it was unwise to make any attempts to enucleate the wall of the sac, that we should be content with opening and drainage.

Dr. William S. Halsted, of Baltimore.

The fact that the digestion of Dr. Cushing's patient was not interfered with does not seem so strange now that we know that the ductus Santorini usually reaches the duodenum independently. It has a minor papilla of its own in the duodenum two or three inches above the major papilla of the combined pancreatic and common bile duct. The ductus Santorini collects the pancreatic secretion from about one-third of the pancreas, and when it anastomoses with the duct of Wirsung or main pancreatic duct it may convey to the intestine the secretion of almost the entire organ. We, too, have observed almost disastrous results from the effect on the skin of the exceedingly irritating pancreatic juice. The permanent warm-water bath affords great relief to these patients.

Dr. T. F. Prewitt, of St. Louis.

Some years since I had a case of cyst of the pancreas which was connected with an enlarged spleen. The patient was a woman who came to the hospital fifteen years ago with a dislocated, as well as very

much enlarged, spleen, and insisted upon having it removed. I removed it and found a cyst of the pancreas connected with it. I removed the spleen and the cyst with it. She recovered, and a number of years afterward was healthy and helping her husband cultivate his farm. My second case was one of considerable interest, as the patient had been in bed four months and was much emaciated. I found a swelling in the median line, and there was evidently much suppuration. I cut down and sutured the wall to the intestinal parietes. I found pus and fluid, and observed that the tumor extended to the backbone, so that I made a counter opening and drainage. I took out several calculi which I believed to be pancreatic and may have been the cause of the trouble. I have no notes on the case, but do not think, however, that there was any history of traumatism.

THE CRANIAL CRACKED-POT SOUND AS A SYMPTOM OF CEREBELLAR TUMORS.

By N. B. CARSON, M.D.,
ST. LOUIS.

My purpose in presenting the following cases of cerebellar tumors for your consideration is, in the first place, to add to the literature of the subject cases not heretofore reported, and, in the second place, to call to your attention a symptom which from my experience seems to have been overlooked or neglected, namely the so-called "cranial cracked-pot sound," due to separation of the sutures from internal pressure, caused by the accumulation of fluid in the brain cavities, produced by the closing of the iter or pressure upon the veins of Galen, or both.

Case I.—E. S., aged six years; good family history, entered the St. Louis Mullanphy Hospital on February 26, 1895. The history given by the parents was: that he had always enjoyed good health until about a year before, when he began to suffer from very severe headaches and vomiting. These attacks increased in frequency until they became of almost daily occurrence. During the fall of 1894 he had the measles. This left him in a decidedly bad condition. The general health was unchanged, but the sight failed rapidly, a daily change for the worse being noted. Besides this, he could hardly walk without assistance.

Physical examination. The intelligence was above the average. One of his teachers told me that he was one of the brightest children in the school. His general condition, with the exception of a slightly anæmic look, was that of a fairly well-nourished child of his age.

The head was large and symmetrical, with prominent parietal and frontal bosses, and bulging forehead. The vault of the cranium was not flattened. Upon percussing the head two distinct sounds were pro-

duced: one the cranial cracked-pot sound, the other a perfectly clear tympanitic sound. He was entirely blind, with widely dilated pupils, which responded sluggishly to very strong light. The hearing was good, as were the other special senses. There was perfect control of the sphincters, and the reflexes were normal and symmetrical throughout.

On February 28th I tapped the ventricles and drew off about four ounces of normal cerebro-spinal fluid. Death occurred on March 15, 1895.

The post-mortem showed the wound to be perfectly aseptic. There was a small hernia at the trephine opening. Upon percussing the skull after the scalp was removed the two sounds were still present, only more marked. The cranial bones were very thin and very hard. The surface of the dura was flecked with whitish bodies or specks, giving it a slightly roughened feeling, while under the dura, over the left occipital region, was an extravasation of blood, one by one and a half inches and about an eighth of an inch in thickness, evidently the result of the violence inflicted by the chisel used in opening the calvarium.

Upon removing the brain a large conical cyst (moderately tense) projecting from the upper surface of the cerebellum was exposed.

The right hemisphere was displaced to the right and compressed, and there was a general anæmic condition of the entire brain substance, and a flattening of the convolutions. The lateral ventricles were greatly distended, while the choroid plexuses were very pale. The foramen of Monro and the Sylvian duct were much enlarged, the latter to the size of a large lead-pencil.

I had seen the patient several times at my office before his entrance into the hospital. When first seen there was nothing to attract attention, except the head, which was quite large; but I was told that it had always been so. The pupils responded normally, and the gait was good. Upon percussing the head with the finger two entirely different sounds attracted my attention: one a distinct cracked-pot sound; the other a clear tympanitic sound. When I saw him first, after the attack of measles, the sight was failing and the gait was decidedly cerebellar, the tendency being to fall to the right side. At the same time I noticed a decided increase in the size of the head.

Case II.—L. B. first came under the attention of Dr. Fry, October 25, 1897. He was a healthy looking lad, aged seven and a half years. The parents, who accompanied him, stated that he was complaining

of severe headache, vomiting frequently, and walking poorly. Their attention had been called to the difficulty in gait in the last six months, especially, but they could remember that for some time previous to that time he had been clumsy, frequently falling. They had also noticed, for some time past, that he had been awkward in the use of his hands. They had also been impressed with the peculiarity of his headaches. They came on suddenly, became very intense for awhile, then disappeared entirely, the child returning to play almost as though nothing had happened.

The peculiar vomiting, typically central, had preceded the headache possibly two months. This history was presented in an unusually satisfactory manner, both parents being intelligent and very observing persons. The vomiting, headache, and incoördination, especially the latter, were all becoming worse when he came to Dr. Fry.

A physical examination revealed the following points: An ataxic gait of cerebellar type. It could not be determined that he inclined more to one side than the other in walking. His head, however, was always inclined to the right shoulder. Both parents affirmed that they had noticed this for some time past. Slight pains of the left side, especially of the upper extremity, seemed to be present. The sensory symptoms were normal. Percussion of the head brought out clearly the cracked-pot sound. The parents could not affirm that there was any increase in the size of the child's head; he had always had a good-sized head. There was probably, from parents' statement, some degree of mental hebetude, but he answered questions promptly and intelligently, and was very amiable and cheerful in disposition.

An examination of the eyes showed a well-advanced optic neuritis and swollen disks. A few days' observation established the fact that pressure symptoms were rapidly increasing. The situation was explained to the parents, and they decided to accept an operation, and he was sent to the Missouri Baptist Sanitarium, where, on November 11th, I operated. The trephine was applied over the right cerebellum as near the median line as possible. The patient took the chloroform badly, and at one time the operation had to be suspended for awhile, while means were taken to resuscitate him. After exposing a considerable area of the cerebellum I was convinced that it did not give a normal resistance to the touch. The convolutions were gently separated and the finger introduced to the distance of about half an inch. I felt quite certain of an abnormal resistance. By pushing the convolutions aside I exposed this point clearly to the view,

and, while it had distinctly the feeling of a pathological condition, to the sight it resembled so closely normal brain tissue that it was impossible to differentiate. The child's condition at this time was so bad that I decided to defer further investigation. He was returned to bed at 12.15 o'clock and died at 2 P.M.

At 4 P.M. the post-mortem was made. The cranial bones were thin and markedly separated at the sutures, the skullcap was raised with difficulty, being firmly held in many places by trabeculæ of the dura, which projected into the sutures. The convolutions were pale and œdematous. The whole brain was quite œdematous. The ventricles were much distended with a large quantity of normal-looking cerebro-spinal fluid. In the right lobe of the cerebellum was found a large glioma, which occupied its central and mesial portions and the greater part of the superior vermis.

The corpora quadrigemina were the site of another deposit of the same nature, and several small foci were found on the apendia of the ventricle.

CASE III.—In 1897 Dr. Fry presented to his clinic a negro lad, aged fourteen years, with all the symptoms of a cerebellar tumor. The head was much distended. The cracked-pot sound was very plain. Later he entered the City Hospital, where he died. On autopsy a large cyst was found in the upper surface of the cerebellum.

CASE IV.—In 1896 Dr. Fry presented a lad aged twelve years, with a diagnosis of tumor of the cerebellum, to the St. Louis City Hospital Medical Society, where he was carefully examined by a number of those present. In this case the cracked-pot sound was very marked, being audible at some distance. The head did not appear abnormally large, and the mother did not think that there had been an increase in its size. The child was afterward taken to another State and passed from our observation, and thus the opportunity for verification of our diagnosis was lost. The symptoms, however, were so classical as to leave little doubt as to its correctness.

ARGUMENT. We have here four cases of cerebellar tumors diagnosed, in three of which the diagnosis was confirmed by post-mortem, in which this cracked-pot sound was present.

This sound is due to a separation of the sutures, and, therefore, is not evident except in those cases where the sutures are not widely separated. It is on that account apparent only in

cases where the sutures have been united and again separated by pressure from within—as in cases of acquired hydrocephalus —and never in the congenital form.

The only other condition wherein I have found this sound present is in extensive linear fractures of the skull.

The cranial cracked-pot sound must not be mistaken for the high-pitched sounds present in some cases of brain tumors, as it is not a high-pitched sound, but the clear distinct cracked sound produced by striking a cracked pitcher or iron pot, and is best made by percussing the cranial bones with the finger instead of with a pleximeter.

It is not necessarily a sound of childhood, either, but may be present at any period after the sutures have become firmly united.

Dr. L. Bremer recently showed me the skull of an adult patient, who had been the subject of a cerebellar tumor causing hydrocephalus, in which the separation of the sutures caused by the internal pressure was beautifully demonstrated, and showing conclusively that this separation may take place in adults as well as in young persons. In this case the cracked-pot sound was not made out before death, because it was not sought. I have no doubt, however, from the condition of the sutures, that it was present.

Gowers[1] says the separation of the sutures does not involve such great force as may be supposed, for the reason given by Hale White, namely, that tumors of the brain cause a remarkable thinning of the cranial bones. This applies especially to cerebellar tumors—and that, on this account, a very slight force only is needed to produce a separation of the sutures. From this we may conclude that a very slight pressure from within might produce a separation of the sutures and the production of the cracked-pot sound comparatively early in the disease—especially in the case of children, who, as we all know, are often the subjects of cerebellar tumors.

In an analysis of 49 cases of cerebellar tumors I found men-

[1] Diseases of the Nervous System.

tion made of the presence of hydrocephalus in 22 of them, so that, with hydrocephalus present in such a large percentage of these cases, this sound must be an important symptom, as my researches lead me to the conclusion that it is to be detected in all cases where the ventricular effusion is sufficient to exert actual pressure.

That hydrocephalus is not always easily diagnosed is evident from the number of cases reported in which its presence was not discovered until the post-mortem. Roswell Park[1] says: "The diagnosis of hydrocephalus can only be positively made when the shape of the skull is changed to accommodate the increase of the fluid within." In two of the cases mentioned above there was no apparent increase in the size of the head, yet the presence of this sound indicated the pressure from within. So that with this sound present I think we can surely diagnose hydrocephalus, and with the other symptoms of brain tumor we can locate it either in the cerebellum or in the neighborhood of the corpora quadrigemina.

In an examination of the literature I find mention made of the cranial cracked-pot sound but twice,[2] once by Keen[3]—where he refers to it as a symptom in cases of acquired hydrocephalus —again by Hall,[4] who mentions its presence in a case of cerebellar tumor causing hydrocephalus. From this I am led to the conclusion that this symptom, which I think one of considerable importance, has been overlooked, as it seems to me that if it had been noticed reference to it would certainly be more frequent.

[Since my return from New Orleans I find, in a work by

[1] Dennis' System of Surgery.

[2] Dr. Keen called my attention, after the reading of this paper, to a case of fracture of the skull reported by him in the American Journal of the Medical Sciences, October, 1888, in which the patient had heard this cracked-pot sound upon percussing his skull after the receipt of the injury. I first noticed this sound in April, 1877, in a case of fracture of the skull in a lady injured in the Southern Hotel fire. Macewen (Diseases of the Brain and Spinal Cord) says he has met with it in three cases of extensive fractures of the cranium.

[3] American Text-book of Surgery.

[4] London Press and Circular, N. S., 1896, vol. lxi. p. 497.

Dr. Ludwig Bruns,[1] mention made of the cracked-pot sound in cerebellar tumors.

He says he does not consider this sound as pathognomic of cerebellar tumors. He further says that he considers it pathognomic only of a local or general thinning of the cranial bones, which naturally does not occur alone in tumors, and is, therefore, not apt to have any pathological significance before the third year, or before the complete closure of the fontanelles. Besides, he finds it in hydrocephalus and acute tubercular meningitis.

With the statement that this sound is not pathognomonic of tumor I have had many opportunities of demonstrating not only in cases of acquired hydrocephalus from other causes than tumor—indeed I see almost daily at present a case of hydrocephalus, not due to tumor, in which the bruit *de pot félé* is present—but also in cases of fractures of the skull. Nevertheless, I do hold that with other symptoms of tumor present it is not only an important factor in the diagnosis, but in the localization as well.

With the statement that it has no pathological significance before the third year or before the complete closure of the fontanelles, I also fully agree, as I have never been able to produce the sound from the heads of healthy children, either before or after the age of three years; nor have I been able to get it from any of the several cases of congenital hydrocephalus that I have examined.]

[1] Die Geschwülste des Nervensystems, Berlin, 1897.

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

I would like to say one word in reference to the peculiar symptom mentioned, the cracked-pot sound. The first time my attention was called to this was by an observation of the patient. The man had fallen from the roof of a veranda and fractured his skull, and the next morning, when feeling his head, he discovered this sound. I called attention to this sound in relation to a case ten years ago, but have never had an opportunity to observe it in later cases of fracture of the skull. I think, however, it is not improbable that in those cases of fissured fracture where the fissure is complete we might possibly find it to be a symptom of value, especially in those cases where we are doubtful whether or not there is a fracture. I should be very glad if the Fellows of the Association would observe this symptom in their future cases and report upon it. In the cases of hydrocephalus I have observed for many years in the Orthopedic Hospital I have found it in cases of the acquired form and moderately early in the case. After some time, when the edges of the bone have separated so as to be no longer in contact, it is impossible to get this sound; but in the early stages, where the edges of the bone are just beginning to separate, the sound may be got and heard as much as ten feet from the patient. It is a valuable sign in connection with tumors of the cerebellum pressing on the veins of Galen, and should receive more attention in the future than it has in the past.

Dr. De Forest Willard, of Philadelphia.

In a case of marked hydrocephalus brought to my office about two weeks ago the existence of an intracranial tumor was suspected, but, owing to the infancy of the child (it being less than a year old), and owing to its lack of cerebral development, it was impossible to decide. In this case the sound was absent, and at such an early age it could hardly have been expected. All the muscles of the body, the arms and the limbs, were in a state of extreme rigidity, the feet and knees were fixed, and it was evidently a case of congenital interruption of development or of obstruction, possibly, of the aqueduct of Sylvius, by which obstruction increasing distention had occurred. I have not yet decided positively in regard to the case, but am watch-

ing it for future developments. It is not probable that any advantage can be obtained by operation.

Dr. Carson. I thought that I had mentioned the fact that this sound only appears in cases of acquired hydrocephalus and in cases of extensive fracture of the cranium. As Dr. Keen has said, where the sutures are widely separated you are not likely to get the sound, nor is it present in congenital cases.

As to Dr. Keen's assertions that it may be an important factor in the diagnosis of fractures of the skull, I will say that I have seen at least three such cases, and in all of them was the fracture extensive. In all cases was the sound appreciable at quite a distance from the patient.

As to Dr. Willard's case, the child was too young to produce the cracked-pot sound, as it does not occur until after the sutures have united and then separated by the internal pressure.

A CASE OF APPENDICITIS IN WHICH THE APPENDIX BECAME PERMANENTLY SOLDERED TO THE BLADDER, LIKE A THIRD URETER, PRODUCING A URINARY FECAL FISTULA.

By W. W. KEEN, M.D.,
PHILADELPHIA.

The following very unusual and puzzling case, in which the appendix became adherent to the bladder precisely like a third ureter, and delivered feces constantly into the bladder, is of more than ordinary interest. The difficulty in making a diagnosis, owing not only to the rarity of the case, but also to the obscurity of the symptoms, will, perhaps, excuse the multiple operations, which were regretted, of course, as soon as the real facts became known.

Mr. W., aged twenty-four years, was first seen with Dr. Charles A. Service, of Bala, on November 28, 1896. When he was seven years of age he had a great deal of trouble in passing his water, and when the family physician examined him, a pin was found well down in the urethra. He does not remember that he inserted it and believes that he swallowed it, but the only known fact is that it was found and removed. This is the only thing in his family or personal history of importance.

In March, 1896, before coming under Dr. Service's care, he was said to have had an abscess of the prostate, which burst spontaneously, the result of which was that a fistula was established between the bladder and the rectum. No urine had ever escaped from the bladder into the rectum, but food had frequently been recognized in the urine, such as fragments of spinach, cranberry skins, strawberry seeds, etc. In addition to this, air sputtered out with the urine, and

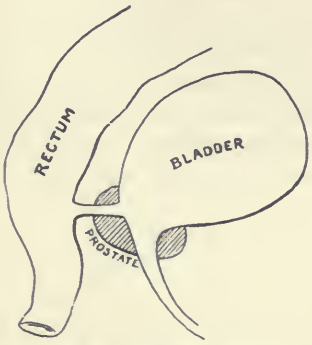
on many occasions the urine had a distinctly fecal odor, in consequence of which he had suffered from several severe attacks of cystitis. When he used an enema or when the bowels were very loose, the discharge of fecal matter was very considerable, and when the feces were solid much less escaped into the bladder. Some time ago, one or more fragments of a calculus were said to have been passed, but there is no evidence as to whether they were fragments of a vesical or a renal calculus.

My first object was to find the two ends of the supposed fistula. He had already been seen by Dr. John B. Deaver, of this city, who, later, throughout the case, was in consultation with Dr. Service, Dr. W. J. Taylor, and myself. Examination by the cystoscope did not reveal any opening into the bladder, nor was any stone found in the bladder. Rectal touch revealed nothing abnormal. The bladder was next filled with milk, when, by the use of Kelly's tubes and the speculum of Martin, of Cleveland, I endeavored to find the rectal end of the supposed fistula by the escape of the milk while he was in the knee-chest position, but without success. On December 2, 1896, another equally fruitless examination was made with cochineal, and on December 5 he was etherized, and renewed examinations were made. The bladder was then injected with air, and the moment that this was done the perineum bulged to a considerable extent, like a cornet-player's cheek, which immediately subsided, however, and with its subsidence the air could be easily heard escaping, presumably into the rectum. This injection was made repeatedly, both in the dorsal, Trendelenburg, and knee-chest postures. While in the latter posture the rectum was filled with water, as I hoped that the point where the air escaped from the bladder into the rectum could be detected by the small bubbles, but none were seen. Our conclusion was that a recto-vesical fistula existed (Fig. 1), and (in view of the bulging of the perineum) that in that part of its winding course it was probably not very far from the surface. We decided, therefore, upon an operation, as follows:

First operation, February 9, 1897, Drs. Deaver, Taylor, Service, Spencer, and myself being present. An incision was made nearly from one tuberosity of the ischium to the other, with a slight convexity forward, about an inch in front of the anus, a steel bougie being inserted into the urethra as a guide. The rectum was then separated from the bladder, until finally the dissection reached to the upper end

of the prostate, a depth of about ten centimetres; but at no point was the sinus discovered. During the dissection the bladder was distended with air several times, but none escaped into the operation wound. The lower border of this wound was then elevated by forceps and the wound filled with sterilized water, as we hoped to find bubbles of air in the water when air was injected into the bladder, but

FIG. 1.



Supposed recto-vesical fistula.

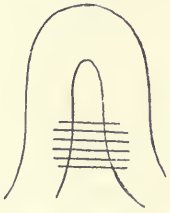
none were seen. Finally, a perineal section was done and the finger introduced into the bladder, but nothing abnormal could be found by touch or sight. The wound was then packed with iodoform gauze and a T bandage applied. He made an excellent recovery, but the passage of gas from the urethra, heard by the nurse as well as himself, and of a considerable amount of fecal matter in the urine, which was recognized as parts of his food, showed that the fecal fistula still existed. On one occasion a small, worm-like mass passed, about one-third of an inch long and a little larger in diameter than a knitting-needle, which naturally confirmed our view of a moderately long, narrow fistula. About the first of March, a sharp attack of epididymitis occurred on the right side.

After discussing all the particulars of the case, we deemed the existence of a recto-vesical fistula quite certain. It seemed to us most probable that the fistula passed from the bladder to the rectum at a point somewhat higher than ten centimetres from the perineum, but that it was so low that it would scarcely be within reasonable reach by abdominal section. On the other hand, if we opened from the perineum and opened the peritoneum, as seemed to be unavoidable,

there would be the greatest danger from fecal infection. We determined, therefore, first to divert the fecal stream by a temporary artificial anus in the left side by Maydl's operation. When this had diverted the fecal stream it was determined to reopen the perineal wound and open the peritoneum, if need be, resecting the coccyx and a part of the sacrum.

Second operation, March 18. Left lateral colostomy was done. Before attempting to draw out the bowel we endeavored to see whether we could obtain any information as to the fistula through the abdominal wound, but this was fruitless. A new complication was found in doing the colostomy, viz., a number of strong, tough, slender, fibrous bands which, at several points, passing from one part of the colon to another, made the colon assume the form of loops. (Fig. 2.) The mesocolon was also so short that the colon

FIG. 2.



Colon thrown into loop by bands.

could not be well drawn out of the abdominal cavity to any considerable extent. The bowel was then sutured after Bodine's method (*Medical News*, January 9, 1897) for three and one-half centimetres, and the loop secured in the wound by a continuous silk suture.

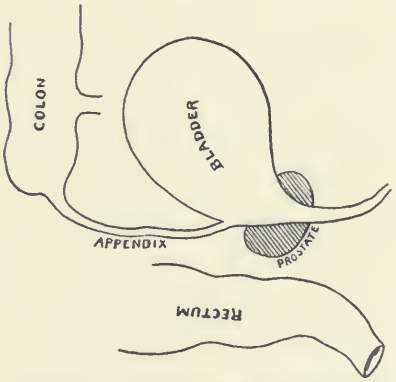
The result of the operation was not altogether satisfactory, as the short mesocolon retracted the spur between the upper and lower bowel so that feces continued to pass into the lower bowel. He went to the seashore on March 31, 1897. On April 8 a second sharp attack of epididymitis occurred on the left side, and the temperature rose as high as 104° F. When he returned, on April 25, he mentioned two facts which immediately arrested my attention: First, that he had repeatedly observed that he could *feel* fecal matter passing into the bladder *before any passed out at the artificial anus*, and, second, that lately, on eating some strawberries, he had *seen* strawberry seeds in the urine *before any seeds had escaped from the artificial anus.* These

two facts seemed to indicate very clearly that the fistula was not between the bladder and the rectum, but between the bladder and some point in the intestinal tract considerably above the site of the artificial anus in the descending colon. This great service was rendered by the artificial anus.

I decided, therefore, to open the abdomen in order to discover at what point the fistula existed.

Third operation, April 26, 1897. A median incision was made and the patient placed in an extreme Trendelenburg position. After considerable search we finally detected a very long appendix dipping down into the pelvis, the tip lying just behind the prostate, and solidly incorporated into the wall of the bladder. (Fig. 3.) That the

FIG. 3.

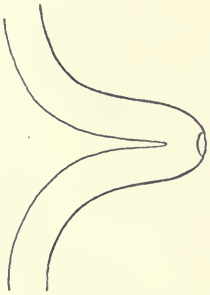


Showing the appendix soldered to the bladder.

length of the appendix and its position behind the bladder were congenital seemed to be proved by the fact that there was a normal mesoappendix dipping down into the pelvis. In order to determine whether the lumen of the appendix opened into the bladder, I distended the bladder with air; but there was a difference of opinion among us as to whether the air escaped into the appendix. It only occurred to me afterward that if we had stripped the colon downward we should have been able to empty the air it contained into the bladder. A fecal concretion lay at the middle of the appendix. Half an inch from the bladder, and with the greatest difficulty, owing to its depth, I dissected back a cuff of peritoneum from the appendix, severed the appendix from the bladder, and covered the stump of the

appendix with the cuff. The meso-appendix was divided, when, owing largely to its length, it was found to be so vascular that five ligatures had to be used to arrest the hemorrhage. The cæcal end of the appendix was next treated in the same way. The belly was then thoroughly flushed out with salt solution and the abdominal wall closed in four layers. Before closing it we inspected the posterior wall of the bladder with the greatest care, to discover whether there was any other possible point of connection between the bladder and the bowel, but found none. His temperature never rose above 100° F. For three days after the operation he suffered so severely from colic that, in spite of the normal temperature and the free opening of the bowels, I was afraid of peritonitis, but after that he recovered very nicely. I kept him in bed for three weeks, and he left the hospital

FIG. 4.



Showing the spur and the artificial anus.

May 15 entirely well. After spending the summer at the seashore and in Europe, he re-entered my hospital in the early part of October, 1897, when the artificial anus had contracted so that it admitted nothing larger than a No. 20 catheter. He had had recurring symptoms of intestinal obstruction on several occasions, which I was afraid was due to the spur at the site of the artificial anus, and, while this had retracted enough to interfere with my purpose in making it, it had not retracted enough to leave the calibre of the bowel free. I therefore determined, he being otherwise in good health, to close the artificial anus and destroy the spur at the same time.

Fourth operation, October 7, 1897. I considered several different plans of closing the artificial anus and safely destroying the spur (Fig. 4) so as to restore the entire calibre of the bowel. I feared to divide

the spur with the scissors through the small fistula, lest I might open the peritoneal cavity or have dangerous hemorrhage. I also rejected Dupuytren's enterotome, and finally decided upon the following plan: An elliptical incision was made around the artificial anus, and the abdominal wall was dissected back from the bowel about two and one-half centimetres away without opening the peritoneal cavity. The bowel was then slit enough to get my forefinger readily into its calibre, when the spur was drawn out through the opening and an operation identical with the Heineke-Mikulicz operation of pyloroplasty was done on the spur, the incision being made longitudinally and then converted into a transverse one and sutured with a continuous catgut suture. Several vessels bled quite freely and were ligated. I was able in this manner to determine by touch that not a vestige of the spur was left, and therefore that no obstacle to the passage of feces remained. The artificial anus itself was now closed, first by a silk suture passed through all of the coats of the bowel and then by a continuous Cushing right-angle suture. The skin was then sutured by silkworm-gut. He made an uninterrupted recovery, the highest temperature being 99.8° F., and he left the hospital October 25 entirely well. The very afternoon that he left the hospital he began to have recurring pains in the abdomen, accompanied with constipation, but Dr. Service was not in the least alarmed about him till the evening of the 28th. I saw him on the morning of the 29th, and found that he had had repeated attacks of vomiting for two or three days and that the bowels had not been opened, but that gas had passed freely. The belly was not distended or tympanitic, but his general condition was bad. There was more or less pain everywhere, but not at any one special point. Possibly, had he not already had so many operations done, I might have decided to do an abdominal section at once, but I confess that in the case of a man who had just got out of the hospital after four operations I hesitated greatly before recommending another operation, especially in view of the fact of the free passage of flatus and that the vomitus was distinctly not fecal. On the 30th there was practically no change in his condition. Early in the morning of the 31st I had an urgent call to see him immediately, and when I got there he was in collapse. Dr. Deaver kindly saw him with Dr. Service and myself, but we concluded that the only thing to be done was to give him a saline intravenous transfusion, in the hope that his condition would improve sufficiently to allow of a

celiotomy. That morning he had a free passage from the bowels. He died at about 1.30 P.M. on the 31st.

Necropsy: Twenty-seven Hours after Death. The abdomen was collapsed. The moment that the abdominal cavity was opened a few small areas of lymph, about five to ten millimetres in diameter, were noticed on the surface of the intestine in the epigastrium and the hypochondrium. The one striking fact, however, was the absolutely black color of the small intestines in the lower part of the abdomen. On examining the condition carefully, I found that seven or eight feet of the ileum had been rotated to the right in one vast volvulus. Its mesentery formed a band about six centimetres in width stretched across the ileum just before it joined the cæcum. This had evidently obstructed the blood supply of the ileum sufficiently to cause gangrene of all the intestine involved in the volvulus, but the pressure was not sufficiently complete to prevent the passage of flatus or of feces. This accounted for the fact that there was neither fecal vomiting nor any distention of the abdomen and that he passed flatus constantly. From the cæcum to the bladder there stretched apparently a reproduction of the appendix which had been removed. It was impervious and had nothing to do with the volvulus which we found. The closure of the artificial anus was complete and the lumen of the bowel entirely re-established.

Remarks. The original diagnosis of his first medical attendant, of a prostatic abscess, seems to me to have been a very reasonable one. No one could anticipate so long an appendix dipping into the pelvis and anchored by its meso-appendix immediately behind the bladder; and a terminal appendical abscess so close to the prostate might well be mistaken, I think, for a prostatic abscess. When he came to me, I confess I never once thought of the possibility of the appendix being involved, nor did it occur to Drs. Service, Deaver, or Taylor. Appendicular abscesses bursting into the bladder are not at all uncommon, but I know of no case in which the appendix has been so thoroughly united to the wall of the bladder as to form, as it were, a third ureter, delivering feces, however, instead of urine, into the bladder. Possibly such cases exist, but I have never come across them. Looking back over the case, I regret very much the perineal operation and the artificial anus. It is

perfectly clear now that the first operation ought to have been an abdominal section, but in view of the symptoms, which I have detailed at considerable length, I do not think the decision reached was unwarranted.

A volvulus such as has been described I have never seen the like of. Unfortunately, it was not so complete as to cause entire obstruction of the bowels. If it had, I should undoubtedly have done an immediate abdominal section, but its very incompleteness misled us as to the exact state of affairs. Whether the bands alluded to as discovered at the second operation, which were certainly very unusual in my experience, had any causative relation to the volvulus, I am unable to say, but the apparent symptoms of repeated intestinal obstruction for months are worthy of note. It is, of course, easy to say, as more than once I have said to myself, that I ought at least to have done an exploratory abdominal section, but in view of the uncertainty of the diagnosis, of the absence of fecal vomiting and other symptoms of complete intestinal obstruction, and of the fact that the poor fellow had already suffered so much in the way of operations, I think that any one of us would have hesitated to recommend a fifth operation.

DISCUSSION.

Dr. Roswell Park, of Buffalo.

The early history of these cases reminds me of two of my own. I note that a pin was found in the urethra, and the patient presumed that he had swallowed it. I had two cases in the same month where I found a pin in the appendix, one in a girl aged thirteen years, and the other a male adult. Neither of them could account for the presence of the pin, which had undoubtedly been swallowed; and I think probably the pin in this case had been swallowed and then ulcerated through. I have found pins in the appendix oftener than I have found grape-seeds.

Dr. N. B. Carson, of St. Louis.

I can add to the case reported by Dr. Keen another case of pin in the appendix.

I would like here to mention a case of a remarkably long appendix that occurred in my practice. The patient died from a septic trouble, and in making the post-mortem we found an appendix at least thirteen inches long. It arose normally from the cæcum, curved outward and upward on the colon, then downward and backward from the bowel to the mesentery, along which it continued to a point opposite its origin, having the shape of a horseshoe. Throughout its entire length, except the last inch, it lay under the peritoneum.

Dr. Keen. It seems to me that, as Dr. Park has surmised, the pin may have been swallowed and so passed from the appendix into the bladder.

A CASE OF FECAL COMMUNICATION WITH THE BLADDER, WITH RESULTING CALCULUS, FOLLOWING APPENDICITIS.

By GEORGE RYERSON FOWLER, M.D.,
NEW YORK.

The following case illustrates one of the possible sequels to appendicular abscess, and is offered for the purpose of further emphasizing the importance of removing the vermiform appendix sufficiently early in an attack of inflammation of the organ, and before the occurrence of suppuration, or, failing this, providing for a safe exit for the suppurative collection, as well as a contribution to the literature of the complications and sequels of appendicitis.

J. B., aged sixty-two years, was admitted to the Methodist Episcopal Hospital, in the Borough of Brooklyn, City of New York, on March 4, 1895, with the following history: Twelve years previously, having up to that time enjoyed good health, he was suddenly seized with cramp-like abdominal pains, accompanied by nausea and vomiting. The pains were at first referred to the epigastrium, but afterward centred in the right iliac region. He was ill in bed for several weeks with fever and anorexia. Finally he passed a quantity of pus with the urine; this was followed by relief of the symptoms. Shortly afterward he began to pass fecal matter with the urine. This has continued to a greater or lesser extent ever since.

Since the first appearance of fecal matter in the urine he has suffered from chronic cystitis, with occasional acute exacerbations. One year prior to admission these symptoms became greatly aggravated, with severe pain in the perineum and penis, together with dysuria and vesical irritability. The pain has kept him confined to his home, and most of the time to his bed, for the past six months. He has fre-

quently suffered from obstruction to urination due to the engagement of fecal masses in the vesico-urethral orifice; but of late, in addition to this, there has been sudden cutting off of the outflow during the act of micturition characteristic of vesical calculus.

Upon admission the patient presented the appearance of a feeble and broken-down old man. Under an anæsthetic the sound decided the presence of a medium-sized calculus. The bladder was at once opened, with the double purpose of removing the calculus and at the same time affording ready exit from the bladder of the fecal matter which passed into it from the bowel. A phosphatic calculus the size of a horse-chestnut was removed.

The right lateral portion of the fundus of the bladder was found adherent to the structures in the neighborhood of the cæcum, forming a deep pouch, from the bottom of which fecal matter in small quantities was forced in the manipulation incident to the examination. No neoplasm was present. Owing to the feeble condition of the patient, the abdomen was not opened.

The patient gained rapidly in strength, but declined further operative interference. He was discharged from the hospital wearing a Bolton-Bangs suprapubic drainage-tube. His family physician reports that the suprapubic opening has healed and that the patient is free from all traces of his former difficulty.

It would seem as if there could be no reasonable doubt that this case was originally one of appendicitis, and that the fecal communication between the bladder and intestine resulted from a rupture of an appendicular abscess, either into both the bowel and the urinary viscus, or into the latter alone. In the latter case the communication occurred with the cæcum as a result of the restoration of the patency of the appendix, following the subsidence of the inflammatory condition.

GUNSHOT INJURIES OF THE SPINE.

By T. F. PREWITT, M.D.,
ST. LOUIS.

In 1891 Dr. J. William White read before this Association an able and exhaustive article upon the "Surgery of the Spine,"[1] in which he discussed fractures and their treatment, refuting the objections urged by various authorities to all operative interference, and sought to show that the results of operative treatment, in properly selected cases, of fracture of the spine are encouraging, and should lead to the more frequent employment of resection of the posterior arches and laminæ. He made no distinctive reference to gunshot injuries and the special features they present.

In 1893 I met with the following case, and the young man having presented himself at my office recently, suggested that a review of the subject of gunshot injuries of the spine might be of interest to the Fellows of this Association.

Howard D., aged fourteen years, of Glasgow, Missouri, while out on a picnic, Tuesday, May 15, 1893, received a shot in the back of the neck from a small target gun (No. 22) in the hands of a young lady, aged fifteen years, who stood immediately behind him, the muzzle being two and a half inches from his neck. He was on a railroad bridge, sitting on one tie and whittling another. The gun was not supposed to be loaded; had been previously snapped several times, perhaps; but with the usual fatality when the victim is in line went off when the trigger was pulled.

The boy fell and was found completely paralyzed on both sides,

[1] Transactions American Surgical Association, vol. ix.

unable to turn his head either to the right or to the left. At the request of Dr. J. W. Hawkins, who had charge of the case, I was called to see him on the 16th, reaching Glasgow at about 10 P.M. I found the boy bright and cheerful, not suffering much pain unless moved. In addition to the complete paralysis of motion the respiration was largely diaphragmatic, and we looked forward to the effect of the anæsthetic with some apprehension.

However, it was agreed that nothing but a search for the bullet and removal of the detached or depressed fragments of bone was to be considered. Accordingly, with the concurrence and assistance of Drs. J. W. Hawkins, M. B. Collins, W. Southworth, and W. M. Pritchitt, and after thoroughly cleansing the field of operation, I made an incision four inches in length parallel with and one inch to the right of the spinous process of the cervical vertebræ, bisecting the point of entrance of the bullet, and, following its track as well as I could, cut down upon the laminæ of the vertebræ.

Pushing aside the structures the point of entrance into the spinal canal came into view. The ball had struck the lower border of the third lamina, driving in a flap-like portion of the bone and lodging in the canal.

The fragments of bone were first picked out, when the small bullet could be seen lying upon the cord, the point partially penetrating the dura. When this was removed there was a considerable flow of cerebro-spinal fluid, showing that the dura had been perforated. I learned subsequently from Dr. H. that this flow continued in great abundance for ten or twelve days, saturating the dressings, the sheet, and bedding, making frequent changes of them necessary.

The wound was dressed by first passing into the canal a strip of iodoform gauze to secure drainage, over this a quantity of bichloride gauze, which was then covered by a thick layer of absorbent cotton. He bore the chloroform well, in spite of the partial paralysis of the respiratory muscles supplied by spinal nerves.

For the subsequent history of the case I am indebted to Dr. H., who kept me advised from time to time by letter. On the 19th, the third day after the operation, his temperature was 99.6° F.; pulse, 76–80; had no control of bowels at times. A letter from Dr. H., dated June 24th, stated that the wound in the neck had entirely healed without suppuration. At that date he could move his left hand and arm, carry it to his face and scratch it. He was not able to move his right leg

until the twenty-ninth day, which continued to improve from that time. He could not move the right arm for five or six weeks; motion returned in the thumb about the thirty-fifth day, and in a day or two in the second finger. On July 31st he was walking about with imperfect use of leg and arm. November 23d, he was attending school and had regained his flesh. His right arm was still paralyzed, but improving slowly. The fortunate result in this case is largely due to the faithful and intelligent after-treatment by Dr. H.

For three weeks after the injury the patient was unable to turn his head to the right or left. For the same length of time he was unable to raise his left hand to his nose, the itching of which gave him great annoyance, and it had to be scratched by the attendant frequently during the day and night. During the first two or three weeks he had occasional involuntary actions from the bowels, and for six weeks he had to be fed like an infant. Great emaciation followed the injury: his weight at the time of the accident was 99 pounds; it fell to 70 pounds in five weeks. I should have mentioned that Dr. H. stated that there was never any loss of sensation, but rather a hyperæsthetic condition.

October, 1897, four years after the injury, young D. presented himself at my office. He had grown taller and developed considerably, with perfect use of every limb except the right arm. This he could flex, and while in a flexed position could bring his arm up to his face, but when in a straight position he could only carry his arm a few inches from the body.

It is not surprising to find that the first operation for fracture of the spine was done for gunshot injury by Louis, in 1762; an open wound involving probably the arches, inviting interference, though that great surgeon recognized the principles involved.

For half a century or more after Cline's deliberately planned operation, an animated discussion, often acrimonious, was carried on as to the propriety of operation at all in fractures of the spine.

In 1867 our distinguished Fellow, Prof. John Ashhurst, collected statistics bearing upon the point, and drew from them conclusions, fully justified at that day perhaps, decidedly unfavorable to the operation (laminectomy). As late as 1894 Manley, of New York, read a paper before the Eleventh Interna-

tional Medical Congress in which he deprecated operative treatment of fracture of the spine.

Cheever[1] says: "As far as laminectomy is concerned, while this may be justifiable sometimes, the latest statistics seem to show that the percentage of recoveries was better in cases not interfered with than in cases that were."

Gunshot injuries have been viewed from a somewhat different stand-point, and some of the opponents of operation in any case of simple fracture have looked with favor upon operation in gunshot wounds. Thorburn[2] tabulated 56 cases of trephining for injuries to the spine, and reaches the conclusion that no benefit can result from operations for most traumatic injuries to the spinal cord, and that operation is therefore unjustifiable. In spite of this emphatic expression of opinion as regards ordinary injuries of the spine, he makes the sweeping exception in favor of gunshot wounds by stating, "as beyond dispute, that in cases of compound fracture of the arches, chiefly gunshot wounds, foreign bodies and bony fragments should be removed and the wound treated antiseptically. No possible harm can accrue from so obvious a procedure."

Pilcher,[3] while speaking guardedly of the probable benefit of operations in fractures of the spine in which the lesion is caused by a force which acts upon a very limited segment of the column, speaks less reservedly of gunshot fractures as a class in which there are special indications arising from a compound fracture, probably septically infected, for immediate enlargement of the external wound, removal of fragments, disinfection, and drainage.

Vincent[4] says: "Whatever be the nature of the injury to the cord, unless it be complicated by serious injury to the abdominal or thoracic viscera, and provided the gunshot wound has involved the posterior or lateral parts of the spine at an accessible region, the surgeon should open up the track of the bullet as far as the vertebral arch, and, after investigation of the nature

[1] Boston Medical and Surgical Journal, September 28, 1893.
[2] Contributions to Surgery of the Spinal Cord. Thorburn.
[3] Treatment of Spinal Injuries, Annals of Surgery, vol. xi. pp. 187–200.
[4] Review de Chirurgie, August, 1893.

and extent of the lesion, extract any foreign bodies likely to compress or irritate the cord. If it be necessary to trephine the walls of the spinal canal he should not hesitate to do so. Such treatment may be found beneficial, and, though sometimes useless, will never do any harm if practised under strict antiseptic precautions."

As in the skull, the gravity of the injury in gunshot wounds of the spine depends upon the damage done to the contents of the spinal canal, save in those complicated by damage to abdominal or thoracic viscera. It will be conceded that gunshot injuries of the spine are of graver significance in general than fractures from falls, blows, etc., and deserve to be considered in a class by themselves as gunshot wounds elsewhere. They are compound, presumably septic, *ab initio*, the projectile crushing and lacerating the structures with which it comes in contact, splintering bone, crushing and devitalizing the cord when traversing it.

Gunshot injuries of the spine may be divided into three classes:

1. Those that simply fracture the arches.
2. Those that invade the canal, crushing the cord and damaging the vertebræ.
3. Those complicated by serious injury to abdominal or thoracic viscera.

As to the first class of cases, the majority of surgeons of to-day would sanction and advise immediate treatment by laying open the track of the wound, clearing out all fragments of bone, laminectomy, if necessary, sterilizing the wound, draining, and applying antiseptic dressings, observing the most rigid antiseptic precautions.

What shall be done with the second class of cases, those in which the ball has invaded the canal, lacerated the cord, and possibly buried itself in the vertebræ? Dr. James[1] said, "If the spinal marrow is wounded, death follows inevitably." Doubtless the great majority of these cases are doomed, yet

[1] Medical Dictionary, London, 1745, Dr. James (quoted by White).

some have survived such an injury for years. In spite of the dictum of Dr. James, severe laceration and even complete severing of the spinal cord are not incompatible with the prolongation of life for years.

Hawley[1] reports a case of gunshot wound of the spine, occurring September 19, 1884; ball (No. 32) entered back two inches to the left of the vertebræ, on a line with the seventh rib. Probe could be passed to near junction of the eighth rib with the dorsal vertebræ. Severe shock with collapse for several days. Complete paralysis of sensation and motion below wound, including bowel and bladder, requiring catheterization of the latter. Complained of sensation of a tight band around his body on a line with the crest of the ilium, some involuntary twitching of the muscles of the lower limb, and slight reflex when toe of left foot was pinched. Had but little pain. Priapism frequent and prolonged. Wound healed in about twenty days. Seventy-three days after injury rigors for two days, followed by high fever, 105° F., occurred, declined, and reached normal in about ten days. Marked tenderness of eighth, ninth, and tenth dorsal vertebræ.

From time of injury there was continued pain and tenderness across the abdomen in the skin, diminished by pressure. His general health improved to such an extent that he attended to the correspondence of a mercantile establishment, and subsequently became president of a bank, and was serving as postmaster at the time of his death, May 9, 1890, which was preceded by rigors and coma, five years and about eight months after the injury.

Post-mortem, fifteen hours after death. Track of ball easily traced. The seventh and eighth dorsal vertebræ found softened and of a dark lead-color. Point of left transverse process of the seventh dorsal had been cut with the ball. Left lamina of the eighth dorsal had been fractured and driven into the spinal foramen. Spinal cord had been nearly cut in two, about one-eighth remaining intact, and this was atrophied. The ends

[1] St. Joseph (Mo.) Medical Herald, December, 1890, p. 519.

had retracted and formed "knotty tubercles." Spinal canal contained a small quantity of pus and showed evidences of inflammation. The ball was found embedded in the body of the eighth dorsal, projecting about four lines into the canal.

In conclusion, the author expresses astonishment at the tenacity of life and the efforts of nature to repair the damage done. He states that he was "More thoroughly convinced of the superiority of conservative surgery over cutting and probing systems of the past."

Hawley's case demonstrates the possibility of an individual living for years with a completely divided cord, dying eventually from inflammation excited by abiding irritation of fragments of fractured bone and possibly the bullet. Had these been removed by operation and the patient survived, it seems not improbable that he might have lived years longer.

In the first case of Vincent's, one of injury to the first lumbar vertebra, removal of fragments of bone and of the bullet from the spinal canal was followed by complete recovery.

The late Prof. Paul F. Eve, of Nashville,[1] relates a case of a soldier, who during the Civil War, while turning in his saddle and firing at a pursuing foe, was himself shot, falling from his horse. The pistol ball entered to the left of the spinal column, about an inch from the spinous process of the sixth dorsal vertebra, in the cavity of which, or that of the seventh, it is supposed to be lodged. He was immediately paralyzed, except his arms and neck. After more than a year the paraplegia continued. He had no control of the left inferior extremity, and the right, which he moved a little or when aided in doing so by others, would frequently take on violent contractions, tonic and clonic spasms, and become forcibly flexed on the buttocks. Sensibility of limbs imperfect. He could urinate with difficulty, and the bowels acted only from drastic purgatives.

An attempt was made to remove the ball by following the cicatrix into the vertebral cavity, but after using one crown of

[1] American Journal of Medical Sciences, July, 1868. Paul F. Eve.

the trephine over what seemed the hole made by the bullet, fear of wounding the sheath of the spinal cord, and thereby exciting inflammation, led to an abandonment of the operation. This man was still living at the date of the article read, July, 1868.

He relates other cases of gravest injury to the spinal cord, where the patient lived from a few months to twenty-two years. In closing he says, "The conclusion, therefore, is indisputable, that death does not necessarily follow a division of the spinal cord."

Admitting, then, that the complete severing of the cord is not incompatible with the prolongation of life for years, what shall be done with this second class of cases? Shall we leave them to survive or perish without attempt to improve their chances of recovery? Admitting that nothing more could be done, would it not be better to do a laminectomy, remove all foreign bodies, spiculæ of bone, the bullet if possible, and the devitalized tissue of the cord, thereby diminishing the dangers of meningitis and myelitis and promoting more prompt healing of the wound? This would be the rational treatment of gunshot wounds elsewhere; why not in the spine? The only additional risk to which the patient would be subjected by this procedure would be shock. Should he survive he would be freed from the persistent menace of conditions always favoring the development of local mischief, and life prolonged indefinitely so far as the spinal injury was concerned.

Some of the strongest and most advanced advocates of operative interference in cases of injuries of the spine in certain cases, would regard injuries resulting in crushing of the cord as beyond the pale of justifiable operation. Thorburn regards a crushing injury of the cord as hopeless. White, in his conclusion, says, "Operation is contraindicated by a history of such severe crushing force as would be likely to cause disorganization of the cord."

These views were expressed in regard to the crushing effect of blows, falls, etc., but would apply *mutatis mutandis* to gunshot injuries of the cord. Mr. Horsley dissents from this view. "I would repeat, therefore," he says, "that, so far from its being

unjustifiable to operate on the spine, owing to the possibility of the cord being hopelessly damaged, it seems to me criminal not to do so."

How far is the cord capable of regeneration and reunion when severed, and what might surgery do in this direction? The possibility of recovery of its function, if the cord be much damaged, was discussed by Cline in his classical case operated upon in 1814. As bearing upon this point, he cites the well-known fact that divided nerves will unite, and the further fact that experimentation has shown that the spinal cord may be almost completely divided by incision and the animal recover.

Bode[1] in speaking of stab wounds cites several cases of perfect healing of wounds of the spinal cord involving not quite half of its diameter.

Thorburn made an analysis of twenty cases (undoubted) of wounds, by sharp instruments, of the cord or its membranes in human beings, and among them found only six deaths. The remainder recovered more or less completely, though not treated antiseptically. Undoubtedly in those cases where there was complete recovery there was complete regeneration.

Chipault says, "In cases of recent division of the cord by cutting instruments, in which it is not necessary to practise medullary resection, suture of the cord, or, strictly speaking, suture of its sheath, of the pia mater, is possible on the cadaver, and very probably would be found so on the living subject. The steps of the operation are very simple: A half-circle of sutures of very fine silk having been applied to the anterior portion of the pia mater, the divided surfaces of the cord are brought together and kept in contact by hooked forceps attached to the meninges whilst these sutures are tied. After this has been done, another half-circle of similar sutures is applied to the posterior part of the cord. If the cord has been incompletely divided, it will be found sufficient to apply a few lateral and posterior sutures. It often happens that one or more nerve-roots are found divided, together with the cord, particularly at

[1] Bode: New Orleans Medical and Surgical Journal, November, 1892.

the lumbar swelling, along which the nerves, forming thick bundles, take a parallel course. It would always be possible in such cases, the author states, to suture the peripheral end of the divided nerve, either to its central end or to an intact nerve root corresponding to a portion of the cord placed below the seat of injury.[1]"

Here the condition is vastly different from the laceration and crushing of the cord, so frequently associated with fractures from blows, falls, and gunshot wounds. The incised wound, leaving the parts accurately in apposition, might well unite by first intention with restoration of function, while the lacerated ends of the cord, separated by devitalized tissue, could hardly accomplish a union by the efforts of nature that would restore function, if accomplished at all.

Maydl suggested that in cases of old division of the cord, or of its functional destruction over a certain extent from sclerosis, two fresh and healthy surfaces made by clean section might be brought together and maintained in contact by sutures. In a criticism of the proposal made by Maydl in these two categories of cases, Chipault says, "Such treatment is anatomically impossible."

On three subjects, examined after death from fracture of the spine, it was found that the retraction of the medullary segments and the extent of the sclerosis necessitated free resection, and that the inelasticity of the cord and the resistance of the ligaments formed by the pia mater prevented apposition of the cut surfaces.

Dr. Robert Abbe[2] says, "It still remains a problem, perhaps, never to be solved, how to connect the lower segment of the cord with the upper when there is a gap of half an inch, and whether this union would restore functional connection with the brain, even though its reflex and independent activity be ever so good. The cases may yet be found where sufficiently narrow transverse lesions will allow the suturing of fresh cut ends of the cord."

[1] Revue de Chirurgie, Paris, August, 1892; British Medical Journal (epitome), September 24, 1892, p. 261.

[2] New York Medical Record, vol. xxxviii. pp. 85–92.

In Hawley's case the cord had retracted and the ends had formed "knotty tubercles[1]". We instinctively speculate as to the possibility of trimming and approximating these cut ends, and suturing them, thus restoring the continuity and with it the function of the cord.

In 1892 Leckie[2] suggested the feasibility of removing a sufficient amount of the spinal column, in cases of destruction of a small portion of the spinal cord after fracture, to permit of the approximation of the separated ends by stitches.[3] Shall we dismiss it with the curt comment, *non possimus?*

Maydl's suggestion, as well as Chipault's criticism, referred to old division of the cord, when it might be supposed that a certain amount of fixation and inelasticity of the cord had

[1] Sir Astley Cooper states (Fractures and Dislocations) "that when a patient survives an injury causing division of the cord for some time, 'bulbs' are organized at each end of it."

[2] British Medical Journal, London, October, 1892, p. 786.

[3] In the Epitome of September 24th, paragraph 261, I noticed a criticism by Chipault on a proposal by Maydl and others to suture of the spinal cord, holding such an operation to be anatomically impossible in the cases suggested, owing to the inelasticity of the cord and resistance of the ligaments. The question of spinal lesions is one in which I have for some time taken an interest, and the idea of resection and suture of the cord in certain cases has presented itself. The operation is one which, I hope, will not be lost sight of by the surgeons, and I believe, notwithstanding the statement of its anatomical impossibility, that it will yet be performed.

It is unfortunately true that in spinal accidents its applicability must be very limited; but in these days when the surgeon feels that nothing almost should prevent his attempting relief, it is an operation which deserves a trial. It may make all the difference between years of helplessness and a life of comparative comfort and hopefulness.

The operation I would propose is to shorten the spinal column in order to overcome the difficulties referred to, and so permit of the divided ends of the cord being placed in apposition and suturing of the membranes. Details of the operation would be required to be worked out on the cadaver, but there should be no insuperable difficulty in the removal of part or the whole of a vertebra, or portions of two adjacent vertebræ, if necessary, by means of gouges or drills, interfering as little as possible with surrounding ligaments, having first ascertained by trephining that retraction of the cord is not so great, or the part requiring resection so extensive, as to render operation obviously impracticable.

Disease only too often performs operations which shorten and variously modify the form of the spinal column, and the surrounding parts adapt themselves to the altered conditions. Is there, then, any vital objection to antiseptic surgery acting in a more scientific manner, trying by operation to restore something like life to some cases which, without its aid, must look forward to a future of such utter hopelessness?

I am, etc.,

D. LECKIE, Medical Staff.

followed division and prevented approximation. Attempts at approximation immediately after injury might be more practicable, as in Briggs' case here cited.

Through the courtesy of Dr. Waldo Briggs, of St. Louis, I have been furnished the following notes of a case in his practice bearing upon the question of partial regeneration, at least, of the spinal cord after destruction by violence.

Joseph R., boy, aged seventeen years, while felling trees in Arkansas, was injured by the trunk of a tree falling and pinning him to the ground. On his removal to the house it was discovered that there was complete paralysis of the lower part of the body from the waist line downward, incontinence of urine, etc. He was brought to St. Louis, and I operated on him January 5, 1898. Patient being very much exhausted from the journey, the operation was deferred until he could recuperate. Patient could not rest easy in any position, sleeping only at short intervals. His temperature at 8 o'clock next morning was 101° F.; pulse 100; on entrance the day before it was 99.5° F., with a pulse of 98. The injury having occurred three weeks previous, there had developed on each side of the hip and over the sacrum bedsores which were devoid of sensation. The operation was by the usual method, a wide chasm being made; the bones were readily removed by bone forceps from the ninth, tenth, eleventh, and twelfth dorsal vertebræ. Numerous fragments of bone were found in the canal and were washed out. On tracing the cord, I found it had been completely severed at about the location of the tenth dorsal vertebra, and I at once conceived the idea of cutting off the ends of the cord and attempting to reunite them, for the reason that I had strong faith in the regeneration of the tissues of the cord. This method was adopted by carrying the sutures first transversely through the dura and pia mater, then longitudinally, in order to prevent the splitting of the column. The sutures were pulled gently until there was apposition of the two ends, when they were tied. Four sutures of very fine catgut were used, and the after-treatment of the wound was the same as adopted in other cases. There was considerable shock the day following the operation. There has been a gradual improvement in both motion and sensation; the bedsores, which were painless previous to the operation, have become very painful. There is partial control over the bladder; motion of the muscles to the knee in one limb and in nearly the whole of the other limb.

Improvement is so great that I feel assured if complete recovery does not ensue, yet there has been enough improvement to satisfy me that in nearly every case we meet the operation is justifiable.

Ostermeyer, after detailing a case of gunshot injury in the region of the tenth dorsal, with the bullet lodged in the canal, as shown by autopsy, says, "There had been a total cutting of the cord, which at no time could have been diagnosticated. The course of a case of gunshot wound may help to make a diagnosis of concussion, contusion, compression, or partial tearing of the cord possible; but in many cases there is no difference in the symptomatology. As it is hard to tell the degree and kind of injury, Demme advises 'that when the projectile is deeply situated, or pieces of bone press on the cord, we should avoid resection or trephining, because we can, beforehand, form no definite idea of the true condition. In this case the course and seat of the bullet could not be determined.'"

No stronger argument could be urged for operative interference, it seems to me, than is here presented against it. If the difference in the symptomatology will not enable us to determine whether there is merely a fracture of the laminæ with depressed bone, perhaps—when there would be little difference of opinion as to the propriety of operation—or destructive injury of the cord with presence of foreign matter, when death must ensue unless the patient can be rescued by operation, certainly it would seem that every patient should have the benefit of the doubt, especially if, as Erichsen says, "the operation *per se* can do no harm."

Upon this point Vincent[1] says, "by operation one may hope to diminish the irritation which leads to meningitis and myelitis. The motive which should chiefly lead the surgeon is the uncertainty of the diagnosis of the lesion of the cord, which may be only a compression, and the conviction that an operation is not dangerous."

Le Gros Clark, while admitting the possibility of benefit in fractures of the spine where the arches only are involved, with

[1] Bulletin et Memoires Soc. de Chirurgie, Paris, 1891.

limited depression, etc., says, "but where are these cases to be met with and how are they to be recognized?" Here again the argument is faulty. If we cannot distinguish between the cases that will be benefited by surgical interference, then it must be shown that the actual mortality is increased by operation, or it is our duty to give every patient with these injuries the benefit of the doubt.

It is not for us, with inverted thumbs, to seal the doom of the prostrate victim. Undoubtedly a very large proportion of such cases must and will die, but certainly it has not yet been shown that some, otherwise doomed, might not be rescued. What if we may never succeed in uniting the severed and retracted ends? Might we not, by cleaning out the wound, removing the irritating agencies, and disinfecting the wound, diminish the dangers of myelitis and meningitis, and thus rescue and prolong the lives of some, even though paraplegic?

In the third class of cases, where the ball has invaded cavities and viscera, the conditions which the complications present would influence the question of operation. In Whittaker's case, in spite of the fact that the ball had traversed the abdomen, operation was done and the patient recovered.

It is unfortunate that writers too often speak of the spine as a whole and operations done upon it as if it were a matter of indifference as to what part of the column was attacked. Nunnelly, in an address on surgery before the British Medical Association in 1869, speaks of resecting the spine. Dr. H. A. Potter, of New York, as quoted by Eve,[8] made an incision from the second cervical to the third dorsal and removed parts of the four inferior cervical and two superior dorsal vertebræ. Eve also (*supra*) says, "I am satisfied that this operation in the dorsal vertebræ, if not almost impracticable, is certainly one of the most difficult in surgery." The context is often necessary to make clear the meaning.

I have succeeded in tabulating 49 cases of gunshot injuries of the spine treated since the aseptic era. Of this number, 24 were subjected to operation, with 11 recoveries and 13 deaths, a percentage of 45.8 recoveries. Twenty-five were not operated upon, with 8 recoveries and 17 deaths.

Tabulated according to regions, we have in the

Cervical: Eighteen cases with 9 operations, and 4 recoveries and 5 deaths. Not operated upon, 9 cases, with 2 recoveries and 7 deaths.

Dorsal: We have 26 cases with 12 operations, with 4 recoveries and 8 deaths. Not operated upon, 14 cases, with 5 recoveries and 9 deaths.

Lumbar: We have 5 cases with 3 operations, 3 recoveries and no deaths. Not operated upon, 2 cases, with 1 recovery and 1 death.

With improved technique and more thorough antiseptic precautions it is believed a larger proportion of recoveries might be anticipated.

While the cases I have tabulated have been limited to the period covered by the introduction of antiseptics, it may well be questioned whether antiseptic surgery has been rigidly followed in their treatment. The doubt upon this point militates somewhat against the value of the statistics offered, yet they show a decided preponderance in favor of operation. So, too, some of the operations can scarcely be dignified as such, since they totally fail to meet the indications.

Conclusions. 1. It is the duty of the surgeon to advise immediate operation in all cases of gunshot wounds of the spine, provided the wound has involved the posterior or lateral parts of the spine at an accessible part, unless the condition of the patient is such as to indicate clearly that he is hopelessly stricken.

2. To wait to see whether nature is competent to repair the damage is to wait until irreparable damage has been done in many cases, rapid degenerative changes, meningitis, and myelitis. The delay permits of the continuance of conditions the removal of which is the purpose of the operation. These considerations apply with greater force, if possible, in gunshot injuries than others.

3. The presence of complications due to penetration of the great cavities and injury of the viscera will influence the question of operation, but not necessarily forbid it.

Cases of Gunshot Injuries of Spine.

Case I. Bailey, S. (*Medical and Surgical Reporter*, Philadelphia, 1879). August 3, 1879, ball entered body midway between root of neck and top of shoulder-joint. Complete paralysis of body and legs; neither sensation nor motion from top of sternum to soles of feet; retention of urine, and bedsores; priapism came on ninth day and lasted eight days. Great emaciation followed, and especially thighs atrophied. Died twenty-third day. Autopsy: Second dorsal vertebra removed and found to contain track of ball; cord disintegrated and in fluid state; adhesions at apex of right lung, and small, smooth-walled, cyst-like spaces at apices. Patient had had years before bronchial hemorrhages.

Case II. Bliss, D. W. (*Medical Record*, vol. xx. 1881). President Garfield, July 2, 1881; ball entered right side four inches from median line of spine and on line of eleventh rib. Great pain in extremities, nausea, and vomiting; incontinence of urine at first. Incisions made at various intervals to permit of escape of pus and secure drainage; small fragments of ribs removed at intervals. Suppuration, pyæmia, and exhaustion. Death in two months and fifteen days. Bullet had fractured both right eleventh and twelfth ribs three and one-half inches to right of vertebral spines, passed through body of first lumbar vertebra, lodging in connective tissue two and one-half inches to the left of spinal column and behind peritoneum, and had become encysted; rupture of splenic artery had occurred, causing fatal hemorrhage; spinal cord was not injured.

Case III. Briggs, Waldo, Case I. (personal note). April 7, 1897, female; ball entered two inches to left of spinous process of tenth dorsal; located by x-ray and fluoroscope in spinal column. Paralysis complete of lower limbs, with loss of sensation. Operation same day: linear incision from eighth dorsal to below top of sacrum; spinous processes of ninth, tenth, eleventh, and twelfth dorsal vertebræ cut off with angular forceps; bullet found embedded in lamina and removed, then the laminæ on either side of fourth dorsal vertebræ removed; numerous particles of splintered bone in the canal carefully removed; wound irrigated daily. Case progressed nicely for a time; paralysis disappeared in a week, and healthy cicatrization took place; at fifth week severe rigor occurred, evidences of meningitis set in, and patient succumbed in about six weeks. Autopsy: Pus found in canal at upper part of wound, and almost complete degeneration of the cord.

Case IV. Briggs, Waldo, Case II. (personal note). Male, admitted to hospital March 13, 1897; five years before received gunshot wound; ball entered to right of spinous process of tenth dorsal vertebra. Complete paralysis below wound; incontinence of urine. Operation five years after injury, two days after entering hospital. After access to the canal, found a piece of bone had been driven into the cord and firmly fastened in the tissues; dura incised, bone dissected out, and wound and dura closed by fine catgut; bullet found in canal several inches above where bone was embedded in cord, and readily removed; second portion of bullet in tissues to left of vertebra. Patient progressed well until fourth or fifth day, when pneumonia set in, proving fatal; died six days after operation.

Case V. Brown, D. B. (*London Lancet*, 1879). January 22, 1879, bullet entered neck near posterior margin of sterno-mastoid, left side upper portion of middle third. Lost all use of arms and hands. Operation January 26, 1879, four days after. Made free openings in middle, found processes of two adjacent vertebræ smashed, and could feel what seemed the cord, pressure upon which caused patient to turn pale and render pulse imperceptible; next day found ball under ligamentum nuchæ and removed it. Wound healed rapidly, but original one continued to discharge pus; patient was sent to Royal Victoria Hospital, Netley; no further report. Recovery partial. Fracture of the processes of two adjacent cervical vertebræ.

Case VI. Bryant, W. C., Case I. (*International Journal of Surgery*, New York, 1896). Woman, aged twenty years, shot in left side of neck midway between clavicle and inferior maxilla and just posterior to great bloodvessels. Immediate paralysis of sensation and motion below diaphragm. Death forty-two hours after accident. Autopsy: Bullet had passed through body of second dorsal, pentrated the substance of the cord, and was found under the right scapula.

Case VII. Bryant, W. C., Case II. (*International Journal of Surgery*, New York, 1896). Male, colored, aged twenty-four years, shot in left side of neck midway between clavicle and inferior maxilla and just posterior to great bloodvessels. Immediate paralysis of sensation and motion below diaphragm. Death fifty-eight hours after injury, due in this case and previous, undoubtedly, "from paralysis of the diaphragm when inflammatory process reached the origin of the phrenic nerve." Autopsy: Bullet, 38 calibre, found embedded in substance of cord between second and third dorsal vertebræ, having carried with it a piece of the victim's shirt collar.

Case VIII. Burt, W. J., Case I. (Daniels, *Texas Medical Journal*, 1886–87). October 28, 1885, female, aged twenty-six years; ball, 45 calibre pistol, entered body three inches to the right of spine, opposite eighth dorsal vertebra; passed to the left and lodged between eighth and ninth left ribs, from which point it was removed. Complete paralysis of motion and sensation below seat of injury; retention (suppression?) of urine for six days. Large gangrenous slough over sacro-lumbar regions; fever; paralysis of upper extremities, coma and death. Died November 16, 1885, nineteen days after injury. Autopsy: Bullet passed lamina and base of spinous process of eighth dorsal; spicula of bone forced against meninges and cord, lacerating former and contracting canal to one-half normal size; extradural hemorrhage; osteomyelitis of seventh and eighth dorsal, and destructive degeneration of intravertebral substance; dura adherent to cord and canal; cord softened and degenerated for three inches.

Case IX. Burt, W. J., Case II. (Daniels, *Texas Medical Journal*, 1886–87). February 8, 1886, male, colored, twenty-eight years; pistol ball, 45 calibre, entered back three and one-half inches to left of spinal column, and four inches above crest of ilium in the direction of first lumbar vertebra. Paralysis of lower extremities; retention of urine and feces. Operation two days after injury; incision down on rib at the orifice of entrance, and removed piece of bone. Died at 11 P.M., "death no doubt hastened by surgical interference." Autopsy: Bullet had passed behind psoas muscle, kidneys, and peritoneum, entered intravertebral foramen between last dorsal and first lumbar, entering into canal and lodging partly in first and partly in second lumbar vertebræ, fractured the pedicles and articulating surfaces of both bones; cord and meninges in track of ball almost totally destroyed.

Case X. Burt, W. J., Case III. (Daniels, *Texas Medical Journal*, 1886–87). November 25, 1885, male, aged twenty-seven years; pistol ball, calibre 38, entered about four inches to right of seventh dorsal, passing in the direction of the spinal column. Paralysis of lower limbs, abdominal muscles, and pelvic viscera; retention of urine and feces for two weeks. Operation November 28, 1885, three days after injury. Incision three inches in length along right side of spinous processes of the seventh, eighth, and ninth dorsal vertebræ, and incision connected with track of ball; bullet not located; drainage-tube. Wound healed rapidly; December 8, 1885, large slough over sacrum; septic fever. Died 154 days after injury. Autopsy: Ball had entered ninth dorsal

vertebra at the base of right transverse process, passed a little downward and lodged in canal; ball completely embedded in meninges and spinal cord; small spiculæ of bone, penetrating cord; cord softened but partly intact.

Case XI. Coppinger (*Transactions Academy of Medicine*, Ireland, 1883). 1882, male, twenty years; ball of small size penetrated right side between sixth and seventh ribs about eight inches from spine, and seemed to have lodged in the spinal column. Paralysis of bladder and rectum immediately. Thirteen months after accident could walk with difficulty, gait ataxic; ankle clonus well marked; control of bladder and rectum had been regained. Recovery partial.

Case XII. Cousins, J. Ward (*London Lancet*, 1891). April 25, 1891, male, aged twenty-two years; pistol ball entered neck four inches above clavicle and one and a half inches to left of median line of neck; ball presumably lodged high up in spinal column. Death forty-eight hours after admission to hospital. Autopsy: Ball had penetrated anterior surface of fourth cervical vertebra, passed diagonally across spinal column and emerged behind root of transverse process of seventh cervical; spinal cord badly lacerated, but not completely divided.

Case XIII. Cunningham, R. M. (*Transactions Southern Surgical and Gynec. Association*, 1888). Woman, aged thirty-two years, shot September 8, 1887; ball, 38 calibre, entered left anterior aspect of neck, midway vertical diameter, passing backward between trachea and vessels and lodged in left side spinal column. Partial paralysis of left arm and leg. Operation next day; common carpenter's gimlet passed along track and screwed into base of bullet; withdrawn with considerable force. Paralysis unimproved; evidences that left anterior column of cord was injured; complication of croupous pneumonia. Death eighth day. Slight laceration of left anterior column of cord, caused by bone.

Case XIV. Cushing, D. (*Bull. Johns Hopkins Hospital*, 1897). November 6, 1896, woman, aged twenty-seven years, shot twice in the neck; wound of entrance, right side of neck on level with cricoid cartilage; bullet lodged in sixth cervical vertebra. Agonizing pains of "pins and needles" character, especially in arms; motor paralysis complete on right side below level of Thorburn's fifth root group on left bronchial; monoplegia up to same level, viz., for deltoid, biceps, and supinator longus muscles; anæsthesia on left side. Lesion pre-

sumably due to intramedullary hemorrhage; motor paralysis disappeared gradually. Recovery.

Case XV. Dana, T. (*American Journal Medical Sciences*, vol. lxxii. p. 120). October 16, 1875, man, aged thirty-three years; rifle ball penetrated right side between eighth and ninth ribs four inches below axillary border. Shock and usual hemorrhage; paralysis of motion and sensation below site of wound. In two weeks bedsores which laid bare sacrum, both iliæ, both femoræ nearly their whole extent. Death February 7, 1876, 113 days after injury. Flattened bullet at site of eleventh dorsal vertebra (left side spinal canal) and adherent to membranes; cord softened and disintegrated below the lesion.

Case XVI. Dedolph F. (*Transactions Minnesota Medical Society*, 1882). May 2, 1881, ball broke clavicle, passing through lungs, lodging in spinal column, where it still remains; pulmonary hemorrhage and hæmatothorax. Left arm paralyzed from injury to brachial plexus; paralysis of lower extremities, bladder, and bowels; ball supposed to be lodged in body of fifth cervical vertebra, indicated by persistent neuralgia. Hæmatothorax absorbed; paralysis of left arm wore off, but persisted in lower extremities. Recovery partial.

Case XVII. Delorme (*Gaz. de Hôp.*, Paris, 1890, vol. lxiii. p. 249). In 1870, man, aged forty-nine years, wound base of neck left side, musket ball; passed obliquely backward, appearing under skin on spinal border of scapula on level with its spine, and removed. No spinal symptoms; suppuration lasting seventeen years; radiating pains in left upper extremity and left half of neck. Operation seventeen years after injury; lamina of seventh cervical vertebra totally removed, laying bare medullary envelope; mass of callus removed; portions of bullet subsequently removed by M. Motz from dorsal column (upper dorsal region). Patient suffered greatly between first and second operations. Ten months after operation patient comparatively comfortable. Upper dorsal region affected.

Case XVIII. Douglass, Justyn, G. D. (*London Lancet*, 1887, p. 255). September 11, 1886, ball penetrated at level of tenth dorsal vertebra a little to left of mesial line. Operation three days after injury; track of bullet followed to first lumbar vertebra, and transverse process of twelfth dorsal removed, but bullet not found; track of bullet scraped and cleaned with solution chloride of zinc, forty grains to the ounce. In seventeen days wound healed except at upper part; secondary ab-

scesses; paralysis and bedsores developed. Death nearly four months after, January 6, 1887. Bullet completely embedded in twelfth dorsal anterior to transverse process; cord pressed upon but not penetrated by foreign body; small spiculæ of bone and pieces of cloth which had been driven in were afterward detached; no apparent change in cord or its membranes.

Case XIX. Dunnavant, H. C. (*Memphis Journal Medical Sciences*, 1889–90, vol. i. pp. 142–43). March 14, 1889, pistol ball, 38 calibre, in dorsal region. Operation third day after injury; several spiculæ of bone removed. Died six days after injury. Laminæ second and third dorsal vertebræ shattered and cord completely severed.

Case XX. Falkner, W. J. (*Medical Press, Western New York*, Buffalo, 1885–86). July 11, 1885, boy, aged thirteen years, shot in dorsal region; ball, 32 calibre, entered at about level of spinous process of tenth dorsal in medial line. Paraplegia and absolute anæsthesia of lower extremities from line of distribution of ninth and tenth intercostal nerves to feet; retention of urine, and urine bloody. Death July 28, 1885, following chill, seventeen days after injury. Autopsy twenty-eight hours after death: Wound of entrance healed; ball had entered canal, clipping off and carrying into canal a small fragment of laminæ, (right) tenth dorsal opposite upper border of eleventh vertebra; cord was found completely perforated, with softening above and below point of perforation; ball found firmly embedded in body of eleventh dorsal and removed, with little alteration in shape.

Case XXI. Forgues (*Arch. de Méd. et Pharm. Milit.*, 1883). Male, aged thirty years, received in a duel a pistol wound, ball entering chest under right clavicle. Expectoration bloody, breathing diaphragmatic, complete paralysis of lower extremities and of bladder and rectum; no plantar reflex; hyperæsthesia at level of mammæ, below this sensation diminished. Death from asphyxia forty hours after accident. Autopsy: Bullet passed through the lung and between the second and third dorsal vertebræ without fracturing the bone; cord crushed; spherical ball (diameter 8 mm.) lodged in canal.

Case XXII. Gowers, W. R. (*Trans. Chirurg. Society*, London, 1878, vol. xi. pp. 24–32). October 10, 1876, male; fired a small revolver into his mouth; bullet passed through tongue, missing soft palate, and lodged in spine. Paralysis of right arm and leg. Died sixty hours after injury. Autopsy: Ball passed through body of second cervical vertebra and lodged between arches of atlas and axis, just behind

vertebral artery, which was uninjured; bullet did not penetrate the dura, but a spiculum of bone had been forced through the dura and was adherent to the cord; cord intact but badly bruised.

Case XXIII. Harwood, Edw. C. (*Bull. Medico-Legal Society*, New York, 1880). Female, aged forty-eight years; two balls entered mouth and passed through tongue, and embedded themselves in cervical vertebra. Operation third day after injury; first bullet removed by enlarging opening with scalpel; second bullet was not extracted. Patient died in three months, abscesses forming. Odontoid process necrosed and disappeared; anterior portion of atlas fractured, but reunited; spinous processes almost destroyed; ball found between second and third cervical vertebræ.

Case XXIV. Hawley, J. E. (*St. Joseph* (Mo.) *Herald*, 1890, p. 519). September 19, 1884, ball entered back two inches to left of vertebra on line with second rib; traced with probe to near junction of eighth rib with vertebra. Complete paraplegia; wound healed in twenty-one days with only slight pus formation and no sloughing or abscesses; eighth, ninth, and tenth dorsal remained tender and painful; gradual improvement in general, none in paraplegia; continued in active business in store; later served as bank president, and served as postmaster at time of death, five years after injury, preceded by severe rigors. Autopsy: The seventh and eighth dorsal vertebræ found softened and dark lead-color; point of left transverse process seventh dorsal vertebra cut by ball, and left lamina of eighth fractured and driven into spinal foramen; spinal cord nearly severed in two, one-eighth only remaining; cut ends of cord retracted, forming "knotty tubercles;" ball embedded in eighth dorsal.

Case XXV. Jackson, Jabez N. (*Langsdale Lancet*, 1896). July 27, 1866, ball, 44 calibre, entered back of neck near margin of occipito-acromial fold of trapezius three or four inches above acromial process, ranging downward and slightly forward. Complete motor and sensory paralysis from level of third intercostal space downward; priapism; tingling pain in tips of fingers. Operation day of injury. Laminæ from sixth cervical to third dorsal were removed; operation arrested by shock; no injury to cord perceptible. Patient rallied from shock, but died in about twelve hours. Autopsy: Ball penetrated fifth cervical vertebra internal to transverse process, passed through body into spinal canal one inch above limit of operation; cord injured in removal of ball, and its condition from original lesion not known.

Case XXVI. Lamb, S. (*Journal of the American Medical Association*, July 9, 1887). Soldier, May 8, 1864, bullet entered just to left of middle line above crest of ilium, left side, and passed to right upward and forward. Lost use of lower limbs; urine was drawn for four days; feces removed by rectal spoon for a long time; gradual improvement. In 1865 appointed clerk in Treasury Department, and had use of all except the left foot. Married in 1869. In 1874, Dr. Lincoln opened abscess of left hip; removed pieces of flannel. In 1881, after complaining for some time with headache, tetanic spasms, was unconscious, followed by other spasms in 1882, and death eighteen years after injury. Last four lumbar vertebræ involved; abundant new formation of bone; bodies of fourth and fifth lumbar vertebræ excavated posteriorly; portions of bodies of third and fifth with most of fourth intervening cartilages ossified into one piece; cauda equina opposite second lumbar vertebra normal; below this, nerves matted together and in the mass small bits of bullet and large pieces of bone; bullet (one-ounce ball) lay in depression in posterior part of body and adjoining left lamina of fifth lumbar.

Case XXVII. Morris (Academ. de Méd. de N. Y.; *Gaz. Hebdom. de Méd. et Chir.*, 1886, p. 1018). Ball fractured tenth dorsal. Paraplegia; compression of cord by fragment of bone. Operation ten days after injury; elevated fragment; ball not found. Complete amelioration of right paralysis, persistence of left. Partial recovery.

Case XXVIII. Mudd, H. H. (*Trans. Amer. Surg. Assoc.*, vol. ix.). Ball passed through fourth cervical laminæ, fracturing them. Anæsthesia of opposite side and paresis of same side. Operation soon after injury; bullet removed; prompt relief and rapid healing of wound. Recovery complete.

Case XXIX. Mudd, H. H., Case II. (Ibid.). Dorsal wound. Operation some months after injury; division of mass of connective tissue surrounding cord; could not be entirely removed. Not much improved.

Case XXX. Mudd, H. H., Case III. (Ibid.). Male, stout, healthy; involvement of eleventh dorsal vertebra. Symptoms not given, except that fever was still present from the inflammation set up. Operation eight or ten days after injury; removed laminæ of two lower dorsal and first lumbar. Died from shock. Autopsy: Bullet found in spinal canal three or four vertebræ below point of entrance.

Case XXXI. Minne, Giovanni (*La Riforma Medica Anno*, 2, No. 5.

"Contributo allo Studio delle Lesion violenti del midullo Spinali Sendrome Fenomeni, la di Brown-Séquard). January 30, 1887, soldier, shot in chest anteriorly; ball entered chest anteriorly, passing through third intercostal space on right and lodged just below spine of scapula on left side. Complete motor paralysis left leg, also paralysis of sensation of heat and cold, and paresis of pain of right leg and right half of body below fourth rib; tactile and muscular sensibility intact on both sides; knee-jerk on left side slightly accentuated; frequent painful contractions of both legs most marked in left; painful girdle about thorax; disturbances of micturition. Recovery complete. Probable lesions: Perforation of third dorsal vertebra with fracture of transverse processes of third and fourth vertebræ, or there may have been simply compression of the cord by dislocation of the fragments of the fracture; involvement of left half of spinal cord as shown by Brown-Séquard's symptomatic syndrome.

Case XXXII. Reporter not given (*New York Medical Journal*, 1877). Wound of back not far from lower angle of scapula. Paralysis of both arms and legs. Paralysis of arms disappeared one month later, and after one year slight improvement in one lower extremity. Partial recovery.

Case XXXIII. Reporter not given (*American Medical Weekly*, New York, 1882). May 31, 1862, patient, a soldier, was struck by Minie ball four inches to right of spinous processes of lumbar vertebræ, nicking inferior border of twelfth rib. Experienced a sensation of intense cold; returned to military duty in November of same year, and served till close of war, 1865. Afterward suffered considerably with back; in February, 1875, his body was drawn over to right side, right thigh flexed on his body, and leg on thigh. Operation twelve years and eight months after injury. February 13, 1875, bullet removed from body of first lumbar vertebra, with small pieces of bone. Improvement after operation, but later suppuration occurred; fever, pain, and swelling left side opposite entrance of ball; pus, fragments of bone, and later a piece of cloth two inches long and a quarter inch thick came away from right side; also an exfoliation from body of vertebra three-quarters of an inch across and three-eighths of an inch thick. Complete recovery.

Case XXXIV. Reporter not given (*Report U. S. Marine Hospital Service*, 1886). February, 1884, male, aged twenty-six years, received pistol shot in back of neck; sent to hospital and discharged well in

April, 1884. In June, 1884, entered Detroit Hospital with severe paralysis agitans involving head; had convulsions July 5th, 7th, and 10th. Death July 10, 1884. Autopsy: Ball, 32 calibre, entered between axis and atlas and lodged in canal, pressing upon the cord with which it was in contact. It had fractured the atlas in two places half an inch apart, and reunion had taken place; ball had become encysted; cord not lacerated; death from rupture of cyst.

Case XXXV. Ostermeyer, Nicholas (*Pester medizinisch. chirurg. Press*, 1893). February 2, 1892, girl, aged seventeen years, shot in back at level of tenth dorsal vertebra. Complete paralysis of lower limbs and bladder, all reflexes absent; pain in back disappeared in two or three weeks; incontinence of urine and feces set in and lasted until death. By middle of March there were contractions of lower limbs with lightning-like pains in them; no atrophy; bedsores and septic infection. Died June 11, 1892, three months after injury. Autopsy: Projectile had penetrated spinal canal, and lay in a softened, grayish-yellow, smooth-walled cavity, the wall consisting of thickened membranes of cord; the cord was lacking in its entire breadth at this point; besides there were bronchitis, œdema of lungs, and purulent cystitis.

Case XXXVI. Perkovske, S. P. (*Vayenno med. Journal*, St. Petersburg, 1879). Soldier, wounded November 22, 1877, in cervical region. Loss of consciousness, paralysis of upper and lower extremities, most marked on left side. Operation eight months after injury, July 14, 1878. Bullet removed by gutter-sound knife and French scalpel. Slight improvement for three days. Death fifth day after operation, eight months after injury. Autopsy thirty-seven hours after death: Arches third and fourth cervical vertebræ greatly thinned and denuded of periosteum; third, fourth, and fifth arches are grown to dura and dura to cord; cord altered opposite third and fourth vertebræ; evidence of intradural hemorrhage.

Case XXXVII. Pespoli, R. (*Giornale Midelo del Ro. Esereito e della Ro. marona*, Rome, 1895, vol. lxiii.). Soldier, age not given; bullet entered lower left cervical triangle, passed in direction of sixth cervical vertebra. Paralysis of upper and lower extremities bladder and rectum; diminished sensibility; priapism. Died on fifth day. Ball had perforated, not fractured, sixth cervical vertebra, rotated somewhat, and lay perpendicularly in spinal canal; medulla completely destroyed.

Case XXXVIII. Phelps, Chas. (*New York Medical Journal*, 1896). Male; bullet, 32 calibre, passed through tongue from tip to base and entered posterior wall of pharynx to left of epiglottis. Great pain in back of neck; internal hemorrhaginous jaundice developed on fifth day; stupor and death on tenth day. Autopsy: Subpharyngeal connective tissue gangrenous at site of wound; bullet lodged between second and third cervical vertebræ at base of transverse processes, both of which were fractured; spinal membranes and cord uninjured, but they had been infiltrated by the gases of decomposition, and there were other evidences of septic inflammation in the cranial cavity.

Case XXXIX. Powel, J. L. (*Amer. Journ. of the Medical Sciences*, 1886). April 29, 1880, soldier, aged twenty-one years; pistol ball, 38 calibre, entered left side of neck, passed through spinal column at seventh cervical and first dorsal, and lodged in right trapezius muscle. Complete paralysis, motor and sensory, of lower extremity and paresis of upper extremities, and numbness of right hand and arm. Operation same day. Ball removed from substance of right trapezius. No pain; respiration easy and not accelerated; became unconscious by noon next day. Died at 5 P.M. Incomplete fracture of neck of first rib; ball had carried away pedicle of first dorsal, nearly severed spinal cord, and carried away greater portion of right lamina of first dorsal; irregular congestion of lungs.

Case XL. Prewitt, T. F. Male, aged fifteen years; ball, 22 calibre, entered posterior part of neck to right of spinous process of fourth cervical vertebra. Immediate paralysis of upper and lower extremities, complete on right side; slight motion of left foot; hyperæsthesia; respiration diaphragmatic. Operation next day. Incision four inches in length parallel to and one inch to right of spinous process of right cervical vertebræ down to lamellæ; portions of lamina of third cervical picked out of canal, and bullet, which had impinged and penetrated dura, removed; persistent flow of cerebro-spinal fluid followed removal of ball for some time. Gradual improvement in all symptoms; wound healed kindly and without suppuration. Recovery complete.

Case XLI. Pyle, W. S. (*Annals of Surgery*, 1894). November 22, 1893, male, aged 22 years, bullet wound of spine over region of last dorsal vertebra. Sensation intact, but loss of motion from hips down one hour after injury; excessive pain in legs. Operation same day. Linear incision over region of wound and portions of three laminæ removed; piece of bullet found loose in canal and removed, having

entered between laminæ of 12th dorsal and first lumbar; cord presented contused appearance and was split in the middle; evidence of spinal hemorrhage slight. Wound healed by first intention; pain disappeared after operation, sensation gradually returned, and motion first noticed seven days after operation; no bedsores; plaster jacket applied. Partial recovery, author thinks due to the operation and subsequent treatment.

Case XLII. Richardson, T. G. (*New Orleans Medical and Surgical Journal*, 1882–83). December 10, 1882, ball entered left chest in front of and one inch below coracoid process; bruised, elevated, and painful spot appeared over sixth and seventh dorsal vertebræ. Complete motor and sensory paralysis from ensiform cartilage down. Loss of sensation as high as fifth dorsal posteriorly; retention of urine. Evidences of consolidation of lungs and bedsores developed. Death, December 24th, fourteen days after the injury. Autopsy: Ball, 38 calibre, fractured third rib in entering chest, ranged downward, perforating left lung near its root; struck sixth dorsal vertebra at junction of body with pedicle, passed into canal, perforated cord, and emerged from canal between fifth and six dorsal vertebræ, lodging in muscles of back; ball passed directly through cord, leaving an anterior and a posterior bridge; cord had undergone softening for an inch or more above and below.

Case XLIII. Severaneau (*Langenbeck's Archiv für klinisch. Chir.*, 1888, vol. xxxvii. pp. 664–65). January 24, 1888, boy, aged sixteen years; ball entered three inches to left of spine, fracturing second dorsal vertebra. Paralysis came on gradually in six days, involving upper and lower extremities, bladder, and rectum. Operation: Followed track of bullet to posterior arch of second dorsal, which was splintered; removed bullet by electric forceps, ten grammes of pus escaped from track of bullet. Recovery complete in six months. Splintering of arch of second dorsal, under which lodged the bullet.

Case XLIV. Small, A. R. (*Journ. Amer. Med. Assoc.*, 1886). May 2, 1896, male, aged twenty-three years; pistol ball, 22 calibre, struck right eighth rib two inches external to costal cartilage. Sensation lost in right leg below knee; motion not impaired; left leg hyperæsthetic below knee and motion slightly impaired; internal hemorrhage. Death May 4th, two days after injury. Ball had wounded pleura, liver, and right kidney, lodging in spinal canal on posterior surface of eleventh dorsal vertebra.

Case XLV. Thorburn (*Contributions to the Surgery of the Spinal Cord*). May 10, 1886, female, aged thirty-seven years; revolver ball, fired at short range, entered immediately below and behind left mastoid process, passing downward and to the right; wound healed in two weeks; bullet lodged superficially three inches to right of fifth cervical vertebra. Immediate paralysis of both upper and lower extremities; complete loss of sensations below neck; diaphragmatic breathing and incontinence of urine and feces. Operation five weeks after injury; bullet removed. Pain and tenderness of cervical spines; paralysis of upper extremity complete, that of lower less; could raise left leg from bed; diaphragmatic breathing continued; incontinence of urine and of feces completely recovered from in four months after operation; locomotion not improved. Died within twelve months.

Case XLVI. Vincent, E., Case I. (*Bulletin et Mémoires Soc. de Chirurg.*, Paris, 1891). Male, aged thirty-seven years; bullet entered at level of tenth dorsal vertebra. Immediate paralysis of lower extremities. Operation two days after injury. Laminæ of eleventh dorsal found perforated; ball extracted, then a large spicula of bone. Slight amelioration followed by myelitis. Death after ninety-four days.

Case XLVII. Vincent, E., Case II. (Ibid.). Male, aged eighteen years; ball, 11 mm. calibre, entered dorsal region between tenth and eleventh vertebræ. Symptoms of complete destruction of cord. Operation third day after injury. Lamina of tenth dorsal fractured; ball found and extracted after enlarging opening. Slight amelioration followed by fever. Death on eighth day. Autopsy: Cord completely crushed.

Case XLVIII. Vincent, E., Case III. (Ibid.). March 5, 1891, male, thirty-five years; ball entered lumbar region at level of first lumbar vertebra to right of spinous process. Sensibility is preserved; pain; micturition is difficult; can move legs, but cannot raise them from bed. Operation two days after injury. Found lamina of first lumbar vertebra fractured; perforated with aid of trephine and removed fragment of bone and portion of bullet; canal free, meninges not compressed; remainder of bullet not found. Pain persisted; micturition always difficult; jaundiced on second day, and on seventh, stiffness of neck-muscles, signs of meningitis and myelitis; walking in three weeks with aid of crutches, and improvement continued, with partial recovery.

Case XLIX. Whittaker (*International Medical Magazine*, Philadelphia, 1896). June, 1896, female; ball entered abdomen in region of stomach. Paraplegia complete and absolute. Operation July 21, 1896, about one month after injury. Long incision in dorsal region over spinal column; arches of eighth, ninth, and tenth dorsal vertebræ removed; bullet found embedded in body of ninth dorsal, protruding bone into spinal canal, compressing cord, which seemed considerably broken up; bullet had been located by X-rays. Wound healed by granulation, but bedsores continued; in August bedsores slowly healed, and general condition good. Partial recovery.

Recapitulation.

Region.		Cases operated upon.			Not operated upon.		
			Deaths.	Recoveries.		Deaths.	Recoveries.
Cervical,	18	9	5	4	9	7	2
Per cent.			55.5	44.4		77.7	22.2
Dorsal,	26	12	8	4	14	9	5
Per cent.			$66\frac{2}{3}$	$33\frac{1}{3}$		$64\frac{1}{2}$	35.7
Lumbar,	5	3	0	3	2	1	1
Per cent.				100			50
Total,	49	24	13	11	25	17	8
Per cent.			54.1	45.7		68	32

DISCUSSION.

Dr. W. W. Keen, of Philadelphia.

In general I wish to express my belief that in gunshot injuries of the spine, operation is indicated unless the symptoms point clearly to a total transverse lesion. I was very much interested in Briggs' case, but I notice that nothing was said as to the condition of the reflexes. This is really of the utmost importance, and unless we have a statement of their condition, especially of the patellar reflexes, I do not think we can judge whether or not there is a transverse lesion of the cord. I noticed that suturing was attempted. Some years ago, when writing on the surgery of the spine,[1] I had occasion to look this matter up, and found that a very few cases of suture of the spinal cord had been reported. In no case was there any reason to believe that good had resulted. I do not feel that suture of the spinal cord has any future. I shall look for the final result in this case with the greatest interest. I am always willing to accept new facts.

Dr. Maurice H. Richardson, of Boston.

Within the last two weeks the question of an injury to the spinal cord came under my observation, but not from a gunshot wound. It was then stated by the neurologist that the hospital must decide the question of interference in doubtful cases. During the past two years there have been two or three cases in which the neurologist has said that there was concussion of the cord. It was determined, in the absence of any well-recognized plan of action, that the hospital was the place to decide this question; but I did not know what to do. No doubt we have all seen cases of compression of the spine, as diagnosed by the neurologist, in which laminectomy had proved fatal. The question is, What shall we do in these cases? And if I could only fall back upon the opinions of the members of this Association, and feel backed up by them in interfering in these cases, I should feel that my visit here had been well repaid. At present I do not feel that we are justified in interfering in such cases where complete paralysis has been observed under palliative treatment. My last operation was on a case which had lasted four months, and the symptoms before operation

[1] Reference Handbook of Medical Sciences, vol. ix.

were very marked, the temperature being 106°, and the pulse was very high. He seemed so low that I did not think that he would last out the night, and I would like to know what the Association would suggest doing in these cases. I feel a hopelessness in interfering where, whether from gunshot or other injuries, experts in diseases of the cord say that the cord is probably compressed or crushed. When we see a case suffering for months, in which death is preferable, I feel inclined to operate.

Dr. H. L. Burrell, of Boston.

This is a subject in which I have been interested for a number of years, and I do not believe that we shall treat these serious cases of fracture of the spine properly until we clearly recognize the pathological condition of the cord resulting from the injury. The only way that we can know the condition of the cord is by operating, and looking and seeing; and I believe that it is wise to interfere in practically all cases of fracture of the spine, especially in gunshot injuries of the spine, except, of course, where shock exists which would contraindicate any operation.

Ten years ago I had a patient, a woman, who jumped from a window and doubled up her spine on itself. When she came under my care she was completely paralyzed, and in thirty-six hours she died, in that condition with which we are all so familiar, of paralysis of diaphragm and extreme distention of the abdomen. At the autopsy I was impressed with the fact that although this injury had produced an injury to the cord, yet at the time of the autopsy there was no compression of the cord. Red softening had already begun in the cord as a result of the trauma, which occurred from the doubling up of the spine on itself.

If any inference is to be made from a case of this description, it logically would result in the necessity for immediate interference. If red softening can occur inside of thirty-six hours from the time of an injury from the pressure of a blood-clot, a bullet, or a fragment of bone, if the pressure is allowed to remain for any length of time irreparable damage will be done to the fibres of the cord. You cannot tell until you have opened up the vertebral column how great the injury may be, and it seems to me clear, although we have not done so, that we should operate in these apparently hopeless cases in the same spirit that we now operate on cases of peritonitis. I have no

doubt that the percentage of mortality will be very great, but certain rare cases will be saved by interference.

I have some statistics on this matter, which I presented in 1894 at the meeting of the British Medical Association, as a result of an investigation of all the cases of fracture of the spine that had occurred at the Boston City Hospital. There were 168 cases of fracture of the spine, and in the first series of 82 cases the percentage of recovery by the so-termed expectant treatment, which consisted simply in placing the patient in bed and treating the symptoms as they arose, was 22 per cent. In the second series of 86 cases, which were treated, many of them by immediate suspension for the correction of the deformity and fixation by plaster-of-Paris jackets, the percentage of recovery was 33 per cent., a gain of 11 per cent., which I submit to you as worthy of consideration in these apparently hopeless classes of cases.

I believe that I was largely instrumental in introducing the use of the immediate rectification of the spine and fixation by plaster-of-Paris, and it seems to me that it was a distinct benefit. Since 1894, however, I have discarded this treatment, for the reason that at best the suspension of the patient and the immediate rectification of the deformity is a crude method of relieving pressure upon the cord, and I have substituted for it laminectomy, which to me seems the more accurate method of treatment. I have not entirely discarded the immediate rectification method, but prefer to make in all cases a clean incision down to the laminæ of the vertebræ, and to remove any foreign body or fragment that may by chance be pressing upon the spinal cord.

Dr. N. B. Carson, of St. Louis.

I agree with Dr. Burrell that in recent injuries of the cord, nothing contraindicating, operative measures are justifiable, but in those cases in which the operation is deferred until inflammatory changes have occurred, little benefit is likely to follow, although a few cases may have resulted favorably. I think in cases of compression of the cord where inflammatory changes have occurred, little benefit will come from an operation. I had a case many years ago in which a man was riding upon a load of hay and attempted to pass under a low doorway. He was caught by the neck and bent forward, causing a complete dislocation of the spine, for which he was brought to the hospital two hours after being injured.

Upon examination, dislocation of the spine in the lower dorsal region was found. Two fingers could be placed under the projections of the upper segment. Loss of motion and sensation was complete, with paralysis of the bladder. He was made to understand his condition, and his consent obtained to do whatever we might think necessary for his good.

I at once suspended him with a Sayre's suspension apparatus, and reduced the dislocation by pressing upon the projecting upper segment while one of my assistants made counter-extension from below. The dislocation was quickly reduced, but with the reduction there was complete collapse. He was immediately lowered, and while extension and counter-extension were maintained a plaster jacket was applied.

He made an excellent recovery and left the hospital in less than three months, apparently perfectly well.

It was an exceedingly interesting study to watch the returning motion and sensation, which were progressive and required several weeks.

In this case the cord was no doubt simply compressed, and the almost immediate relief before any permanent changes occurred accounts for the good recovery.

Dr. P. S. Conner, of Cincinnati.

There is one point of much interest, and that is that the character of the injury can only be determined by exposing the damaged part. If a bullet has lodged upon the spinal cord, or if a piece of bone or a blood clot is pressing upon it, there is no question but that, if possible, relief should be afforded by operation. If the cord has been extensively damaged, especially if it has been completely destroyed, I do not believe that surgery can help. In reference to the symptoms, they are by no means clear as indicating the character of the lesion, and it seems that we should give the individual the benefit of the doubt. It is true there is a very heavy mortality attending operative interference, and it may be that there are almost no cases that can be rescued, but every rescue is a life saved, and it is well enough to be content with a moderate amount of gain rather than an excessive amount of loss.

Dr. F. S. Dennis, of New York.

In reference to the subject of the plaster-of-Paris jacket in these cases, I would say that some time ago I published, in the *Annals of*

Surgery, a large number of cases treated by this method. In two cases the patients were completely paralyzed in the legs and arms, and there was loss of reflexes and control over the pelvic organs. These patients had been in this condition for months, and by extension and counter-extension and the use of the plaster jacket they were able to recover and walk about. There is one thing I should like to suggest, and that is the administration of large doses of the iodide of potash during the time the patient wears the plaster. This seems to have an influence upon the absorption of the meningeal thickening, and I have seen excellent results from this drug used in this connection.

Dr. Carson. With regard to the application of the plaster jacket, I have used it in cases where the application has been made after inflammatory changes had taken place, without any benefit whatever. I have applied it several times since seeing the case I referred to, where some time had elapsed after the accident and inflammatory changes had taken place. In none of these cases was any benefit derived from its use.

Dr. W. H. Carmalt, of New Haven.

The discussion seems to have taken a wider range than the paper of the President indicated, and while in the case of a gunshot wound there can be no hesitation in operating to reduce infection to a minimum, in cases in which there has been no open wound, as referred to in the discussion, my experience has been very mixed. I have in mind two cases of severe injury to the upper part of the cord, with total paralysis below the neck in each, supposed to be due to a similar lesion, viz., fracture-pressure in each. In the first case the operation was proposed and, indeed, urged upon him, but it was refused, and the man was put in a plaster-of-Paris jacket with extension. This case occurred about a year ago, and the patient is now walking around the ward pushing his chair before him. The other case occurred more recently; the operation, likewise, seemed indicated; it was proposed, but in the light of the previous cases not urged. It was again refused. The same treatment was adopted, but the patient died promptly at the end of three days.

So far as I can see we are still groping very much in the dark, and must, therefore, do as we think best in each case, not being able to formulate any general rules.

Dr. Burrell. The cases reported by Drs. Carson and Carmalt are extremely interesting. It is worthy of note that in one of the cases referred to this afternoon, where traumatism and severance of the spinal canal had occurred, there should be reunion of the fibres by the formation of connective tissue. It seems to me that these cases will be rare. These cases of fracture of the spine go on for a more or less indefinite period where they survive the first shock — for a year to eighteen months and sometimes three or four years, with complete paraplegia. Then there takes place an apparent improvement, and occasionally a partial recovery.

I believe that this apparent recovery is due to the absorption of the inflammatory connective tissue that has been thrown out, and which has pressed upon the cord. This inflammatory tissue as it goes on becomes organized, and finally becomes absorbed, and thus relief from the pressure on the cord is obtained. This view of these cases would agree with Dr. Dennis' remarks, where the use of the iodide of potash was of value.

Dr. Prewitt. I am much gratified to have this subject discussed. So far as the ordinary fractures of the spine are concerned it is a comparatively new field, although Dr. White has gone over the subject very thoroughly, and Dr. Burrell has written admirably upon it. It really constitutes a distinct class of surgery.

The cases referred to by Dr. Carson and others are what we would call simple fractures, and ofttimes result from a displacement of the body of the vertebra itself. We may have dislocations without fractures of the bone, which dislocations will of course press upon the cord. In many of these fractures that are simple there is a fracture of the lamina and consequent depression of the bones. Gunshot wounds are always compound, and the question is what shall we do with such injuries? That they are fatal in most cases everybody knows, and very few escape that result. If the lamina alone be injured the case may recover. Undoubtedly, if we knew the condition surgeons would act very differently. If we only knew that there were fragments we would cut down and remove them. It is that very uncertainty that makes the question of what is best to do difficult to answer. The symptomatology is the same whether there be severance of the cord or not. What harm can we do in these cases, if they are going to die anyway, if we cut down and disinfect the wound and place it in a better con-

dition than it was before? If we can lessen the likelihood of meningitis, would it not be wise to do so?

As has been said, "the fate of a patient with a compound fracture often hangs upon the surgeon who first touches it." Why? Because the proper treatment of it consists in the prompt and thorough disinfection of the wound, followed by antiseptic dressings. Is not this equally applicable to gunshot injuries of the spine which are compound and presumably infected? Should we allow septic conditions and foreign materials to cause a meningitis or myelitis? In the case I report the bullet had penetrated the canal, impinged upon and injured the cord. It was removed, and the patient recovered. Can we doubt that it would have proved fatal if no operation had been done?

Hawley's case lived five years and a half, and then died from the effects of the persistent irritation caused by fragments of bone and the presence of the bullet in the canal. Would an operation at the time of the injury, for the purpose of removing these foreign bodies and disinfecting the wound, have added to the gravity of the case? Is it not apparent that his condition prior to his death, minus the presence of these sources of inflammation, would have permitted of his living for many years longer? He served as postmaster for many years, was a bank president, and was a very useful man during the five and a half years that he lived. If, in these apparently hopeless cases, we could only save one in one hundred we have saved a life, and even if we do not restore them to perfect health it is well to save a life and make a useful man.

As to Dr. Keen's criticism, while Dr. Briggs did not say anything about the reflexes, he trimmed and sutured the ends of the cord, and said it was severed completely. As a result, a man who previously had had no pain in the bedsores which had developed, soon recovered sensation in them, and shortly afterward movement of the legs, showing that there must have been much improvement. The case seems to me a very striking one, and the question is can we not do the same thing in other cases? If so, should it not be done immediately? By removing the conditions prone to produce a myelitis or meningitis we are doing much good. If we can get rid of the infection we will have no inflammation; and if we can prevent this, why not do it at once, and not wait, as some have advised, for six weeks? If a case can be rescued it cannot be done at the end of six weeks.

The plaster jacket is an admirable thing, especially where there

has been a dislocation. I have seen several of these cases with good results. If a dislocation exists to such an extent as to sever the cord by pressure, the very fact that there has been this complete dislocation makes the case a very hopeless one, but it is right to reduce it if possible. It should be immobilized just as we would do anywhere else. Dr. Burrell has shown us excellent results from this very treatment. As I have said before, gunshot wounds are local, and are to be looked upon differently from ordinary fractures. Simple fractures of the lamina sometimes occur without pressure upon the cord, and we do not need to operate in those cases. It is where there is pressure that we need to interfere. If you have a gunshot wound with fracture of the laminæ, you will almost necessarily find spicules of bone, and long after the injury fragments of bone and pieces of lead have been found. I must confess that when I started this subject I looked upon operative procedures as useless. In some cases the bullet has lodged in the canal and the patients have lived a long time. The question is, Would these cases have been better off if the bullet had been removed? As Erichsen points out, we cannot do much harm anyway, and if we operate and rescue a few of them it is worth the attempt.

HYSTERIA FROM A SURGICAL STAND-POINT.

By JAMES E. MOORE, M.D.,
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Hysteria is usually considered to be strictly within the province of the neurologist or the general practitioner, but surgeons meet with it in many forms, and should they fail to recognize it will frequently be guilty of grave errors in diagnosis and prognosis.

Hysterical symptoms frequently appear as a post-operative complication, and when unrecognized may lead to unnecessary anxiety. A rise of temperature is not a part of the clinical history of hysteria, but we may have a post-operative rise of temperature in a hysterical patient which cannot be accounted for in any other way than by calling it a neurotic temperature. I recently performed a curettement upon a hysterical patient who developed mild delirium and a temperature of 102.8° on the second day. She reminded me that some three years previously, when I had performed a trivial operation upon her, she had had fever, which had been relieved by injecting medicine into her arm. I ordered the nurse to administer an eighth of a grain of morphia hypodermically, and in two hours her temperature had disappeared. We have doubtless all been worried over a temperature of this character following a laparotomy.

Persistent hiccough after the administration of an anæsthetic is sometimes purely hysterical. I remember one instance in which this symptom was so persistent that I began to fear for my patient's life, when I ascertained that her father had hiccoughed for three days before he died, and that she had always feared that she might die the same way. She was given the

positive assurance that her condition was so entirely different from her father's that she could not possibly die in that manner, and an enema containing asafœtida was administered, which gave prompt relief.

Persistent cough or emesis following an operation may be purely hysterical.

I once operated upon a splendid specimen of physical manhood who suffered from aphonia for some days afterward, which I was at a loss to explain until I learned that he had suffered from a similar attack immediately after business reverse.

Every laparotomist should be on guard against phantom tumors.

When a neurotic female presents herself for surgical treatment, and the subjective symptoms are out of all proportion to the objective, we should be upon our guard, for operations under these circumstances are seldom of more than temporary benefit. These patients frequently derive a morbid pleasure from operations, and are perfectly willing to submit to the most dangerous surgical proceedings, when, by careful observation, the surgeon may satisfy himself that their sufferings are purely imaginary. Such patients should go to the osteopaths or Christian Scientists and add to their marvellous cures rather than fall into the hands of unscrupulous would-be surgeons.

I recently saw a woman who had her "rectal pockets" split and her ovaries removed, and who had called on me, expecting to submit to an operation for appendicitis. Her abdomen was rigid all over, and she complained of exquisite tenderness upon pressure over the right inguinal region, but her temperature and pulse were normal. She had all the symptoms of hysteria minor, and seemed quite disappointed when informed that she did not have appendicitis and did not need an operation.

Hysterical hyperæsthesia, anæsthesia, paresis, or seemingly complete paralysis may be so mingled with real pathologic conditions as to mislead the most skilful diagnostician. I have found Patrick's suggestion with reference to the rapid shifting of the border of the affected area in hysterical hyperæsthesia or anæsthesia a very valuable aid in diagnosis. (Gould's *Year*

Book, 1897, page 805.) If the hyperæsthetic area be outlined and lightly marked, and another examination be made a few minutes later, the outline will have changed.

It is in joint and spine ailments that the surgeon is most likely to meet with hysteria, and it is of so frequent occurrence here, and ofttimes so closely resembles real disease, that he must ever be on his guard lest he mistake the shadow for the substance. Sometimes the hysterical joint affections so closely resemble tubercular joints as to deceive very good diagnosticians, but ordinarily one needs but to know that there is such a malady as a hysterical joint to be able to recognize it.

The hysterical joint usually, but not always, follows an injury. There may be slight atrophy, but it will only be such as is due to non-use or bandaging of the limb, and should not be mistaken for the marked atrophy accompanying tuberculosis. In hysteria there is no local rise of temperature, but it may be subnormal. There is no marked swelling, although there may be slight puffiness about the joint. There is marked restriction of motion in hysteria, but it differs very materially from that so characteristic of tuberculosis. It varies from one minute to another, and may temporarily disappear when the patient's attention is directed to something else. The muscular spasm is very different from that of tuberculosis. It is more marked and is voluntary in character.

A hysterical joint is usually deformed. The deformity is apt to be a flexion, more marked than in real disease. In some joints, for example, the hip, the deformity may be greatly exaggerated and different from what would be expected from disease.

In making a diagnosis the age and sex are to be borne in mind, hysteria being more common in young women, although it may develop at any age and in either sex. When convulsions or other hysterical symptoms are present they may be helpful to the diagnostician, but it is quite possible for a hysterical person to have a tubercular joint. I have one case of hip-joint disease under treatment at the present time in which the hysterical symptoms cause the friends more anxiety and myself more trouble than does the tuberculosis.

A hysterical joint occurs as a rule in a hysterical patient. The pain is not that of an inflamed joint, but is a hyperæsthesia. The deformity may resemble very closely that of tuberculosis, but there is a difference. The symptoms are all exaggerated, and the whole condition gives the experienced examiner the impression that the patient is playing a part.

The prognosis is good, for, while some cases are very persistent, they eventually recover. It is said that a hysterical contraction may become permanent, owing to organic changes brought about by the prolonged abnormal position, but such a condition has never come under my observation. Were it not that some very able observers have reported this condition, I should think that an error in diagnosis had been made, for in numerous instances where a joint had been flexed for a long time I have seen such speedy relief as to preclude all possibility of the presence of any organic change. The miracles performed by various pretenders are doubtless of this character.

Hysterical patients, fortunately, are very susceptible to suggestion, and what one does for them is not so important as it is to insist that whatever is done will cure them. I have obtained the best results from administering an anæsthetic, reducing the deformity, or rather, allowing it to reduce itself, holding the limb in proper position for a short time and insisting that a cure had been wrought, and that the patient is able to walk. Very little of the anæsthetic is necessary, as they yield to it very quickly.

It is questionable if a cutting operation is ever necessary for the relief of a hysterical deformity. Tenotomy is a very safe procedure, and it may be justifiable in an extreme case. I believe, however, that the operation helps through suggestion, rather than by relieving contracture. Cases reported in which organic changes are said to have taken place in the spinal cord following hysterical contractions should not be classed as hysterical cases, as they are evidently cases of organic disease, and if hysteria be present at all it is merely a coincidence.

It is comparatively easy to make a diagnosis of a hysterical spine, because the deformity does not resemble that of disease,

and the patient complains of extreme pain and sensitiveness at the seat of deformity, which does not obtain in real disease.

Comparatively little has been written upon this interesting topic, and I know you will bear with me if I give briefly the history of a few selected cases illustrating hysteria as met with by the surgeon.

Case I.—A young woman from North Dakota, referred to me by Dr. Hall, of Minneapolis. She was eighteen years old, fair-haired, blue-eyed, red cheeked, well developed, and healthy-looking. She gave a history of having had a fall some months before, injuring her hip, from which she had been lame ever since. Upon examination I found the right hip flexed and adducted to a marked degree, just as one would expect to find it in a dislocation upon the dorsum. Upon manipulation a distinct slipping, as of the head of the femur upon the dorsum of the ilium, could be felt and heard. The temperature was 100° F., and the patient complained of great sensitiveness of the joint. There was slight atrophy of the affected limb. The thigh could not be abducted or extended to the normal limit, and the patient complained bitterly of efforts in that direction. She had been to a local osteopath, who had pulled her leg, both literally and metaphorically.

My diagnosis at this time, based upon the history as I understood it, and upon the temperature, atrophy, and deformity, was traumatic subluxation of the hip, with a subacute synovitis, due to the violent manipulation of the quack. Owing to the large amount of adipose about the patient's hips, it was impossible to decide whether the trochanter was above Nélaton's line or not. I applied a long extension splint, which seemed to hold the limb in proper position and to relieve pain. After a couple of weeks the temperature had disappeared, and the patient seemed to be doing so well that I allowed her to go to her Dakota home, wearing the splint. For three months reports from the family and physicians were very favorable. At the end of four months came the report that she was very much worse, that the brace no longer prevented the hip from slipping, and that the knee was flexed and rigid. The family physician reported that she had hysterical convulsions. My suspicions were at once aroused, and I advised the patient to come to Minneapolis, to the Northwestern Hospital, immediately, which she did.

I found the hip the same as when I had first examined her, save that there was less tenderness and no rise of temperature. The knee was flexed to a right angle and perfectly rigid. It was perfectly normal in appearance and without local heat, although the patient complained of great tenderness in it. I at once made a diagnosis of a hysterical knee, with a strong suspicion that the whole trouble was hysterical. I announced to the hospital internes my intention of performing a miracle, and ordered them to chloroform the patient. As soon as a few whiffs of the anæsthetic were taken the contracted muscles began to relax, and the limb fell into its normal position, with nothing but its own weight to aid it. Both joints were normal. A plaster cast was applied from the toes to the umbilicus, and the patient was assured, upon regaining consciousness, that she had been cured. At the end of a week the cast was removed and the patient was told to walk, which she did, and she has been able to walk ever since.

What deceived me at first was the rise of temperature and decided slipping of the joint, together with the understanding I had that she had been unable to walk since the accident. I have since learned that she had walked for some time after the accident. This patient shortly afterward developed a curvature of the spine which differed in appearance from any curvature due to disease, which improved very rapidly under very strong, and consequently painful, shocks from a static machine. This patient can cause a click in that hip at will, which can be heard and felt. I have placed my hand upon the trochanter, with the patient standing, and tried to make out just what happened. She throws her weight upon the limb and suddenly rotates the femur forward, causing the tendons of the gluteus minimus, pyriformis, and obturator internus to slip over the top of the trochanter with a snap. Dr. Shaffer, in his paper on "The Hysterical Element in Orthopedic Surgery," has given a very satisfactory explanation of the knee-click, but I have never heard the hip-click explained, and offer the above explanation, which, after careful study, I believe to be correct. The temperature she had when I first saw her was probably due to an inflammation of the bursæ under these tendons.

The prompt relief afforded by treatment in this case is, of course, conclusive evidence of the correctness of my diagnosis.

Another characteristic point is the small amount of anæs-

thetic required to relax the spasm, for, while it is possible to relax the spasm due to tuberculosis, it requires profound anæsthesia.

Case II.—In May, 1897, I was called by Dr. J. T. Moore, of Minneapolis, to see a young woman from the southern part of the State who claimed to be a great sufferer, and who had come to the city to have an abdominal tumor removed. About two years ago she was examined by a local physician, who told her that she had a tumor in her abdomen, which he proposed to remove. She came to Minneapolis at that time, and was examined by Dr. Moore, who told her that he could find no tumor, and advised her to go home. Since that time she has written to the doctor, telling him of her great suffering. Once within that time her home physician has written, stating that the tumor was growing quite rapidly, and that he feared it would soon become inoperable.

In appearance the patient was as healthy a nineteen-year-old girl as you could find in a day's journey. In trying to get a history, about all I could elicit was that two years ago she had been told that she had an abdominal tumor, and that she had been a great sufferer ever since.

Upon examination we found the pelvic organs perfectly normal. When we undertook to palpate the abdomen she complained of the great pain it caused her. After a little, however, her rigid abdomen relaxed, and we could feel a large solid mass just below the umbilicus, which we soon found to be the spinal column. We then found that there was marked lordosis, and that the lumbar spine was several inches from the table when she lay upon her back. We then had her stripped, when she showed the characteristic gait and deformity of a double congenital dislocation of the hip. Both trochanters were fully two inches above Nélaton's line, and the lumbar spine was so arched forward that it could readily be felt through the abdominal wall. This girl has a decided tumor in her abdomen, but one that causes no pain, and one that few would care to operate upon. Her pain is clearly in her mind, and she probably would never have had it had she not been told that she had a tumor, for that same tumor had been there for seventeen years without causing her the least pain. She was not at all pleased with our diagnosis and prognosis, and was decidedly disappointed when we sent her home without an operation.

Case III.—I was recently called by Dr. Emily Fifield, of Minne-

apolis, to see a patient about fifty years old, who stated that she had been a great sufferer all her life, and that for many years her uterus had been paining her so much that she had finally made up her mind to have it removed. She stated that she had had her cervix "fixed up" some time before by a Boston physician, but without benefit. She was very emphatic in her statement that she would not submit to anything short of a vaginal hysterectomy. She was so exquisitely sensitive that a satisfactory examination could not be made. We finally persuaded her, however, that she did not need so grave an operation as a hysterectomy to relieve her suffering, and gained her consent to do what we might deem advisable after examination under an anæsthetic. She was sent to the Northwestern Hospital, where an anæsthetic was administered, and upon examination we found that she had no uterus. The enterprising Boston gynecologist who had "fixed her cervix" had evidently removed that organ without saying anything to the patient about it. Her vagina was packed with iodoform gauze, and she was assured, upon regaining consciousness, that her uterus would cause her no more pain.

Case IV.—Last month I was called by Dr. P. M. Holl, of Minneapolis, to see a patient of his who had met with an accident to her knee some months before, and had been unable to walk since. At the time of the accident the doctor stated that he found a small wound over the patella, caused by the point of a nail. He dressed it properly and obtained prompt union, but the patient complained of great suffering. When I was called the doctor stated that he could see nothing wrong with the knee, but that his patient was very nervous and complained of pain. Upon examination I found the whole limb slightly atrophied. There was no swelling, but when I made pressure upon any part of the knee the patient complained of pain. When she was busily engaged in conversation, however, she did not notice pressure. She would not bend the knee or allow it to be bent, but I had no difficulty in bending it when her mind was upon something else. This was a hysterical joint, pure and simple. The atrophy was due to the bandaging of the limb.

The patient was ordered to apply a domestic remedy that had been strongly recommended by her mother, and was directed to begin to walk after a certain number of days. We stated very positively that she would be able to walk quite well in three weeks. In four weeks she was perfectly well.

It is well to remember that it is not safe to make the time allotted for recovery too short in a case of this kind, lest our prediction may not come true and the power of our suggestions be greatly diminished.

CASE V.—The patient, a female, nineteen years of age, came to the Northwestern Hospital from the southern part of the State. She had been confined to bed for about three months by severe pain in her back and hips. Upon examination I found exaggerated reflexes and great sensitiveness in both lower limbs. There seemed to be restriction of motion in both hips, but not of the kind met with in hip joint disease. She stated that her limbs had grown very much smaller during her illness. She said she could not walk on account of the slipping of her hip joints. When asked to stand, she could only do so when supported by two nurses. By placing the hands over the trochanters a peculiar slipping could be felt in both hips, and her joints looked as if they were dislocated, but the trochanters did not rise above Nélaton's line. The restriction of motion and deformity did not resemble very closely any disease or deformity with which I am familiar. I had my suspicions; but for fear of making a mistake I requested Dr. Jones, a neurologist, to examine her, to exclude, if possible, a spinal cord lesion. Dr. Jones pronounced the case one of hysteria, and she was treated accordingly, and in a few weeks went home perfectly well. The slipping in this case was exactly like that in Case I., and was undoubtedly caused in the same manner. The slipping and snapping of those joints, and the position the patient assumed when required to stand, excited the sympathy of all the nurses and had already deceived a number of competent medical men.

CASE VI.—Quite recently Dr. Ames, of Minneapolis, referred a maiden lady of uncertain age to me for an examination and opinion. She stated that there was something alive in her abdomen that she wanted cut out. She said that after eating a meal she could feel "him" crawl up from the lower part of the abdomen to her stomach, and after eating what he wanted he would return. Upon a careful examination I found a floating kidney and hemorrhoids, and advised her that if these were properly cared for her dyspepsia would probably be cured. The last report from this case was that "he" was making regular trips up and down her abdomen at least three times a day, and that she believed that her only salvation was in a laparotomy.

HYPERTROPHY OF THE PROSTATE GLAND, AND SUGGESTIONS IN REGARD TO ITS TREATMENT.

By L. C. LANE, M.D.,
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One of the important advances of surgery in recent years has been the treatment of the enlarged prostate gland. A few points on this subject are offered in this paper.

The prostate lies in a triangle, which is described by drawing from the apex of the coccyx two lines, of which one extends to the upper end of the symphysis pubis, and the other to the lower end of the symphysis.

The average dimensions of the normal gland are as follows: its greatest breadth is one inch; from base to apex it measures one inch and a half, and it is three-quarters of an inch thick. According to Retzius, it is contained in a four-sided ligamentous capsule, which resembles a pyramid, of which the base is the triangular portion of the deep pelvic fascia, and the summit is the pubo-vesical ligamentous fascia.

The prostate is an integral constituent of the male generative apparatus. In the infant the gland is in miniature form. Its absence was observed and reported by Gandon and Deville. In cases of exstrophy of the bladder, Chopart and Littré have found absence of the prostate. Castration prevents its growth, and atrophy of the testes in the adult is followed by prostatic atrophy.

The prostate is constituted of glandular and muscular tissue, and according to Hyrtl and Henle the muscular tissue considerably exceeds the glandular in amount; Hyrtl says the proportion is as three to one.

The prostate consists of two lateral lobes and a median lobe,

yet the median one may be so small as scarcely to be distinguishable from the lateral lobes. The number of names by which the median lobe has been designated by surgeons are ample guarantees of its usual presence. Home names it the median lobe, Morgagni the caruncle, Huschke the isthmus, Velpeau the pathological lobe, and Amussat styles it the transverse portion of the gland.

The prostate is traversed by the ejaculatory ducts, which converge anteriorly and unite a short distance behind the apex of the gland. Since the middle lobe lies between these ducts, it does not reach to the anterior end of the gland.

In 25 per cent. of men who have reached sixty years of age the prostate undergoes enlargement to an extent which interferes with micturition. The hypertrophy may involve the lateral and median lobes in like degree, or one of the lateral lobes may be more enlarged than the other. The enlargement of the median lobe is the chief factor in impeding the outflow of urine. This fact was announced by Everard Home in 1811, but whether his observation was original, or whether he learned it from the papers of John Hunter, to which he fell heir and which he is charged with confiscating, cannot be determined.

Further observation has found that the hypertrophy of the lateral lobes may also be an element in urinary obstruction.

The median lobe may develop as an upright protuberance, and thus oppose the entrance of a sound that reaches it in front, or the exit of the urine lodged behind it; or the median lobe in cylindrical shape may surround the neck of the bladder; and, projecting inward and upward, it is so situated that when the urine is forced against it it folds on itself, and the outlet of the bladder becomes completely closed. The writer has seen this form of retention. Again the three lobes may, through enlargement, come in contact and partially or entirely prevent the escape of urine.

Prostatic enlargement arises from hypertrophy of the muscular and glandular constituents. Henle, who has exhaustively studied the anatomy of the prostate gland, states that the enlargement of the median lobe is the usual cause of urinary

retention in the old, and, further, that this is due to thickening of the muscular element of the lobe; in fact, is due to abnormal development of the internal sphincter of the neck of the bladder.

According to Virchow, there occurs in prostatic hypertrophy an amylaceous degeneration of tissue, a transformation into a structure which, similar to starch, gives a blue reaction with iodine. In a clear lecture, which the writer heard in 1875, Virchow stated that structures which have been thus transformed become a *caput mortuum*, which can never be restored to normal tissue. Though it may not be reducible to original tissue, yet, through massage properly applied and long continued, the writer has found that the enlarged organ can be diminished in volume.

The hypertrophy may exist chiefly in the posterior and inferior part of the prostate, and then, as Reginald Harrison has shown, the enlargement may not interfere with the passage of the urine nor the introduction of a catheter. In such a case digital exploration, per rectum, would discover a large prostate, and still micturition would not be impeded, while in a patient in whom the anterior portion was not greatly enlarged there might be complete retention.

Prostatic enlargement through retention of urine may cause an adynamic cystitis, in which there are thickening of the vesical walls, excessive formation of mucus, and finally septic changes in the urine. These conditions occurring in the aged subject render his life miserable, and they appeal strongly for relief.

Treatment. An attempt to relieve the patient may be made by a resort to medication, and of remedies advised, the writer has derived benefit from the administration of muriate of ammonia, which is best given in combination with camphor water. Meanwhile the bladder should be daily irrigated with a solution of quinine in the proportion of two grains to the ounce of water.

An adjuvant to this medication is massage of the gland. To do this, let a large sound be passed into the bladder and retained there by an assistant, who will press the end of the instrument

against the vesical surface of the prostate. A bivalve anal speculum is next to be introduced, and, being dilated, a finger is to be introduced between the blades, and massage of the gland accomplished. This kneading should be continued for fifteen minutes and repeated daily.

By the means mentioned the writer has given satisfactory relief to a few patients whom he has treated in the early stage of prostatic enlargement.

Benefit has also been obtained from injecting the tincture of iodine, combined with ergotine, into the gland. This can best be done through an anal speculum.

With castration as a means of relief the writer has had no experience, yet from the favorable reports of surgeons who have adopted this method it is probable that castration will have a permanent place in the treatment of prostatic enlargement.

As the sacrifice of the testicles is a mutilation to which few men are willing to submit, the surgeon finds less objection to operations in which the prostate is directly attacked and the portion removed which obstructs micturition. As routes to reach the part the following have been used: Suprapubic, perineal, and posterior. The writer has operated by the suprapubic as well as by the posterior route, and herewith follows the report of a case done in each way:

1. A man aged about sixty years, the subject of enlarged prostate, had lost the power to pass urine four years previously, and during that time had used a catheter. Life had become a burden to the man; in fact, he preferred death to living as he was doing. Suprapubic section was done, the enlarged middle lobe uplifted with toothed forceps and excised with curved scissors. The wound was partly closed and the bladder drained by a fenestrated tube, which, traversing the penis, emerged from the suprapubic wound. Daily irrigation was done. Recovery in two months, when the man had control of his bladder and could retain his urine for four hours.

2. A man with prostatic hypertrophy, in which the gland had attained great dimensions, was operated on by a posterior incision, in which the prostate was reached by a cut similar to

that employed by Kraske to reach and excise the cancerous rectum. When the gland was reached a heavy sound was passed into the bladder, and so pressed on as to uplift the gland into the incision. When the prostate was thus rendered accessible a large portion of it was excised. The patient's condition was not materially improved, and he survived the operation only a few days.

The experience had in this case forcibly taught that the prostate gland is much more difficult to reach from behind than by the suprapubic route. The bleeding in both cases was less than had been apprehended, and it was easily controlled.

It is probable that had the patient on whom suprapubic section was done been treated in the prone position, so that the urine could have escaped constantly, the recovery would have been more rapid. The writer has observed that tolerance of the prone position is soon acquired, and, since this position averts the backward gravitation and stagnation of the urine, it is a more rational one than that of dorsal recumbency.

SOME CASES NOT OPERABLE.

By DAVID W. CHEEVER, M.D.,
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When, nine years ago, in the President's Address before this Association I said that the future of surgery was almost without limit, I excepted certain surgical operations as being on trial, their future value being undetermined. Among these were: Resection of the pylorus for malignant disease; resection of cancerous intestine; removal of the spleen, of large bronchoceles, of the larynx, the pancreas, the prostate gland, the normal ovary. Sharing the enthusiasm of the new promoters of aseptic surgery, I still felt that our tendency would be to undertake unfit operations. A decade has proved that these misgivings were not unfounded, and that many operations, like the above, are worse than useless.

To quote from what I then said: "The functions of some important organs are still undetermined. The ductless glands, for instance: the spleen, the thyroid, the thymus, the suprarenal capsules: an ignorance of their functions renders the surgeon unable to predict the consequences of their removal. Of what avail the brilliant operation to excise a double goitre, if it is to be followed by an obscure degeneration of the nervous or glandular systems? Again, in organs of known function, the limit of the digestive power of different portions of the alimentary canal is not yet definitely learned. How can we get along without a gall-bladder? How important is the pancreas? Can the duodenum supplant the stomach in nutrition? How much ileum can be removed without starvation? What will the rectum digest? All these questions have a direct bearing on modern surgery."

It may be safely assumed that in the closely packed economy

of nature every part has its uses, and, although all may not be essential to living, or the removal of some may not be fatal, yet the impairment of function which follows their loss is detrimental to health and to happiness. Unless, then, they are so diseased as to be worse than useless, and unless the disease can be totally cured by their removal, it is not justifiable to operate on them. The sole exceptions to this rule are the prospect of relieving pain—continuous pain—or of preventing loathsome filth and discomfort. The strict application of this rule would prohibit operations on most internal cancers and on many in the mucous passages. Senn found the neighboring glands affected in seventeen out of eighteen cancers of the pylorus.

The removal of the spleen is quite uncertain in its effects on the other organs. Some authorities, after trial, deliberately condemn the extirpation of the larynx for carcinoma.

It can hardly be supposed that the pancreas can be dispensed with as a fat-digesting organ. The prostate is the closing valve of the bladder, and its removal may be followed by urinary incontinence. Castration alters the whole system in the male. The removal of normal ovaries, or those partially normal, inflicts the same sort of injury on the female, viz., abnormal nervous and nutritive symptoms, that castration does in the male. Neither relief of pain nor of uncomfortable sexual impulse are constant sequences. The suprarenal capsules have a very serious office in the body, though little understood. It is questionable whether any of these mutilations render future life desirable, even if endurable.

Cancer removed from the mucous passages of the mouth and throat is followed by death within a year.

In middle life, and much more in age, the mental effect of a severe operation is often unpleasant, and an altered temper and disposition have followed, to my knowledge, the removal of the kidney. Insanity, or dementia, has resulted, in my hands, from the shock of prolonged dissection of the axilla for a small scirrhus of the breast in an elderly woman. Fear, although unjustified, either by the operation or by its successful results, has, in one case, terminated in melancholia and death within three

months. Among the earliest cases I had as a surgeon was an aneurism of the external iliac artery—truly a brilliant chance for a young surgeon; a more careful examination of the patient revealed an aneurism of the arch of the aorta, and the operation was happily declined. As a consultant I once dissuaded from an operation a case of malignant disease of the glands of the neck and of the groin on the same side of the body. The argument used was that these tumors were the croppings out of a disease which extended through the body. No operation was done; the patient died in three weeks of vomiting and peritoneal irritation.

Among the most discouraging cases are the trifacial neuralgias of the epileptiform type described by Trousseau. Here repeated resections are vain and temporary, because the trouble is central in the brain. Even the ablation of the ganglion of Gasser sometimes, perhaps often, fails to cure.

A tubercular testis, in my judgment, had better be palliated and temporized with than wholly removed, and the same is true of the ovary. An active citizen, past middle life, among my patients, with tuberculous nodules and cysts in both testicles, is free from general tuberculosis, and not now a sufferer, though twenty years have passed without operation. A female occasionally consults me from whom the uterus and ovaries were removed, at her request, by a surgeon. She is far from well. A monthly nisus occurs, with great distress, followed by a large flow of serum from the vagina. She also suffers from neuritis of the pelvic nerves.

However simple or successful a careful shortening of the round ligaments may be in some cases of retroversion, there are cases occurring among us where hernia, both single and double, has followed. Here one infirmity has been exchanged for another. The fixation of the uterus to the abdominal wall has been condemned in women during the child-bearing period.

I have presented, perhaps too strongly, the discouraging side of surgery, because the successful side is sure to be the more prominent in all surgical literature. It is wise to remember failures, and it is sometimes wise to stay our hand.

A CASE OF APPARENTLY HOPELESS INFILTRATION OF LEFT AXILLA AND SCAPULA BY ROUND-CELLED SARCOMA.

Extirpation Attempted and Abandoned; Extensive and Severe Wound-infection, Followed by Disappearance of the Tumor.

By MAURICE HOWE RICHARDSON, M.D.,
BOSTON.

The following case seems of interest in connection with the subject of the disappearance of malignant tumors under the influence of a general toxæmia, whether artificially or accidentally produced. The occasional cure of malignant disease by internal medication excites not only interest but incredulity. Incredulity is natural enough in view of the rarity of so fortunate a sequel, but it assumes error in observation on the part of the surgeon and error in diagnosis on the part of the pathologist. It may dismiss as valueless what many regard as evidence of the greatest importance—the history and gross appearances of the tumor. Scepticism may be so extreme that carefully-observed cases are thrown out, for one reason or another, though I cannot but think chiefly for the reason that they were successful. As an illustrative example, I would cite one of the most extraordinary cures of sarcoma that I have ever seen. In this case Dr. Garland and myself, at the time of operation, made the diagnosis of hopeless malignant disease of the abdominal wall. Dr. Whitney made a careful microscopic examination of the tumor, and reported it to be a fibrosarcoma. After some months' treatment by Coley, the tumor, though as large as a child's head, disappeared. Not only did the tumor

disappear, but there resulted in the two-inch scar of the exploratory cut a ventral hernia, although the incision was made in an abdominal wall at least six inches in thickness.

Not that one is to be blamed for incredulity—on the contrary, such a recovery excites it to the greatest degree—but if we are incredulous we must abandon as worthless that evidence upon which we are accustomed to base the character of new growths. For example, some years ago I examined a man of thirty, a farmer, who had been operated upon on April 30, 1892, by a well-known New York surgeon for tumor of the bladder. Soon after the operation, which had been very successful, the tumor reappeared. On October 11, 1892, I examined the patient and found a large tumor of the bladder involving the prostate. The case seemed absolutely hopeless. There was a median scar between the umbilicus and the pubes, the abdominal wall was somewhat retracted, and in the pelvic region was pushed upward by several smooth, elastic, rounded masses. The surgeon who operated wrote me January 10, 1894, that it was one of the largest bladder tumors ever seen at the hospital; that all who saw it agreed that it was malignant, and that the diagnosis was sustained by the report from the laboratory. The microscopic diagnosis was carcinoma. In January, 1894, I was informed by a brother-in-law of this patient that Mr. B. had been cured by a "cancer doctor." I saw the brother-in-law, August 6, 1898, and was told by him that Mr. B. was "perfectly well." A permanent recovery after unmistakable recurrence of a carcinoma of the bladder is certainly extraordinary, but in this case it seems to have taken place. The lacking testimony is the present physical examination, which I have not had the opportunity of making. That the man is apparently well six years after recurrence of a carcinoma of the bladder cannot be denied.

If a cure by means other than surgical is, from the very fact of cure, declared sufficient proof of a mistaken diagnosis, there seems little use in presenting evidence. I am convinced, however, that a considerable number of tumors, pronounced malignant, and in fact malignant, disappear under local or systemic

conditions which are artificially produced. The curative influence of micro-organisms upon malignant growths, whether during the course of an accidental wound-infection or under the influence of a deliberate toxine injection, is a hopeful indication of far-reaching possibilities of good.

The following case has been under the observation of Dr. R. H. Fitz and myself since 1892. In the beginning it was pronounced a malignant lymphoma, and some fifteen affected glands were removed by myself. Dr. Beach removed a single tumor later. In 1896 I operated for an extensive tumor which had involved the left axilla, the left scapula, and the skin over it.

The history which follows is taken from the records of the Massachusetts General Hospital, vol. 274, page 288:

John R., aged four, of good family history, entered the Massachusetts General Hospital, October 6, 1892. He had always been well until six months before entrance, when lumps appeared in the left side of the neck, and rapidly increased in size. There were no other symptoms. Examination showed a well-nourished boy. On the left side of the neck were numerous enlarged glands. They were movable, elastic, neither knotted together, tender, nor fluctuating. There was no redness of the skin. A few small glands could be felt on the other side of the neck, but none abnormally enlarged in the axillæ or in the groins. There was no leucocytosis, and the spleen was not enlarged.

The glands were removed from the left side of the neck on October 7, 1892. The patient was discharged well October 15th. Fowler's solution in one-minim doses three times a day was ordered.

On October 2, 1893, Dr. Beach removed two small glands which had appeared in the region of the scar. The health had been excellent. The patient had taken Fowler's solution for a few months after discharge from the hospital. In June, 1893, one small gland back of the old incision was removed through a one-inch incision, and a large gland was shelled out from the left submaxillary region. The glands were dark colored, and looked malignant. The boy was discharged well on the 8th of June.

In October, 1896, this patient, now aged eight, re-entered the hospital. Soon after his discharge in 1893 small lumps were noticed in the left axilla. These gradually increased in size. They never were

painful. Their growth from December, 1895, to October, 1896, was rapid. The child had been under treatment by Dr. Fitz, and had taken Fowler's solution. He was generally well and active.

Physical examination showed a boy of good development and nutrition, but of pale color. A large mass was evident in the left axilla. It extended to the border of the pectoralis major, and it involved the tissues of the anterior and posterior surfaces of the scapula, as well as the scapula itself. Posteriorly the skin over the tumor was adherent, raised, and discolored, evidently infiltrated directly from the scapular mass. In the posterior triangle of the neck there was a movable, well-defined tumor as large as an olive, and two as large as peas. A small, hard mass was also perceptible just below the left clavicle.

On October 5th (1896) an extensive dissection was made of the axilla and of the mass about the scapula. The incision extended from the upper portion of the axilla downward in the mid-axillary line, passing over the summit of the tumor. The growth was found to infiltrate the border of the pectoralis major and the latissimus dorsi. It was dissected away from these muscles, the incision being enlarged sufficiently by backward extension. The dissection was carried down to the axillary artery and vein and backward to the scapula. In the front the tumor was less adherent, but behind the new growth merged imperceptibly into the skin, which was hard and on section porky. The induration and the infiltration involved and surrounded the axillary vessels. Further dissection was not attempted, the pulse and respiration being found too poor to warrant prolonging the operation. The posterior triangle of the neck was not touched. The wound was closed with silkworm-gut. A gauze wick was left in for drainage. The wick was removed on the 6th; on the 8th he was out of doors; on the 9th he was in a wheeled chair; on the 18th the temperature was found to be 103°. A fluctuating spot at the upper angle of the wound was opened, and about an ounce of pus removed. Sulpho-naphthol dressings were ordered for the whole wound, which had become septic. The temperature remained high. On the 1st of November the respiration became labored. On the 2d of November the patient was seen by Dr. Fitz, who found the left chest dull in the lower back, with absence of respiration. The pleural cavity was aspirated just below the angle of scapula, and fifteen ounces of a turbid fluid were removed, with great relief to respiration. The pulse was from 180 to 200. It did not seem possible for the boy to recover. The axillary wound healed slowly by granulation; the pleurisy became an

empyema. This was finally opened freely. With the existence of the extensive wound infection, the induration about the scapula disappeared and the tumor slowly subsided. At the end of six months I visited the boy at his home in Townsend, and could find no sign whatever of the mass. The scapula rested in its normal position upon the thorax; the induration of the tissues had entirely disappeared, with the discoloration and infiltration of the skin. There was not the slightest evidence of any growth about the scapula.

The microscopic report from Dr. Whitney was as follows:

A large lobulated mass, composed of glands and fibrous tissue, which had infiltrated the muscles. The mass was nearly the size of the two fists. Microscopic examination showed the structure to be solid masses of small round cells, separated by relatively large areas of connective tissue. In places these could be seen following the course of the bloodvessels in the perivascular lymph spaces.

Round-celled sarcoma originating in the lymph glands.

W. F. Whitney.

I have been able to examine this boy several times since he left the hospital. There is no doubt whatever of the complete disappearance of the tumor of the axilla and of the scapula. At my last examination I found one or two enlarged glands on the *right* side of the neck. The boy wrote me in August, 1898, that he was feeling very well.

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